INTERNATIONAL FIELD YEAR FOR THE GREAT LAKES

YGL BULLETIN NO. 7

INTERNATIONAL HYDROLOGICAL DECADE · DECENNIE HYDROLOGIQUE INTERNATIONALE

IFYGL

US IHD
1965 - 1974

Y 1973

INTERNATIONAL FIELD YEAR FOR THE GREAT LAKES

IFYGL BULLETIN NO. 7

JULY 1973

UNITED STATES

DEPARTMENT OF COMMERCE

DEPARTMENT OF DEFENSE

DEPARTMENT OF INTERIOR

DEPARTMENT OF TRANSPORTATION

ENVIRONMENTAL PROTECTION AGENCY

NATIONAL SCIENCE FOUNDATION

NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

CANADA

ENVIRONMENT CANADA

DEPARTMENT OF ENERGY, MINES AND RESOURCES

ONTARIO MINISTRY OF THE ENVIRONMENT

ONTARIO MINISTRY OF NATURAL RESOURCES

Published by the National Oceanic and Atmospheric Administration,
U.S. Department of Commerce, Rockville, Md. 20852

CONTENTS

CONTENTS (Continued)

CANADA

Editor	John Sandilands
Publications assistant	Barbara Farnworth
Typing	Alix O'Hara

GROUNDWATER EROSION ALONG PART OF THE NORTH SHORE OF LAKE ONTARIO

(IFYGL PROJECT 38 TW)

A detailed examination of the surficial geology along the north shore of Lake Ontario in the Bowmanville-Newcastle area was undertaken by the Ontario Ministry of the Environment (MOE). The objective of the study was to determine the origin, type and areal distribution of deposits within the overburden in order to assess the amount of groundwater discharge from them to Lake Ontario for the IFYGL program. A sequence of photographs of the exposures were used extensively as an aid in mapping the areal distribution of the deposits.

The study area is situated along the north shore of Lake Ontario and extends 24 kilometers (15 miles) from longitude 78° 29' W to longitude 78° 46' W.

The land surface along the shore of Lake Ontario rises abruptly as bluffs above the level of the lake. The bluffs diminish to only a few meters near the mouths of major streams entering the lake and reach a maximum height of over 42 meters (140 feet).

Groundwater discharge, in the form of springs or seepage faces from permeable beds, plays a major role in reshaping the morphology of the bluffs. Discharging groundwater can carry a considerable quantity of sand and in effect undermine any overlying material. Springs, originating within permeable beds in the bluffs, have created ravines by continuously eroding headward. Some of these ravines have developed into steep-walled, amphitheatre-like openings behind the bluffs, with narrow ridges between the amphitheatres and the shore. Examples of the erosive effect of groundwater resulting in mud flows, ravines, amphitheatres and slump blocks are illustrated in Figures 1 through 6.

S. N. Singer

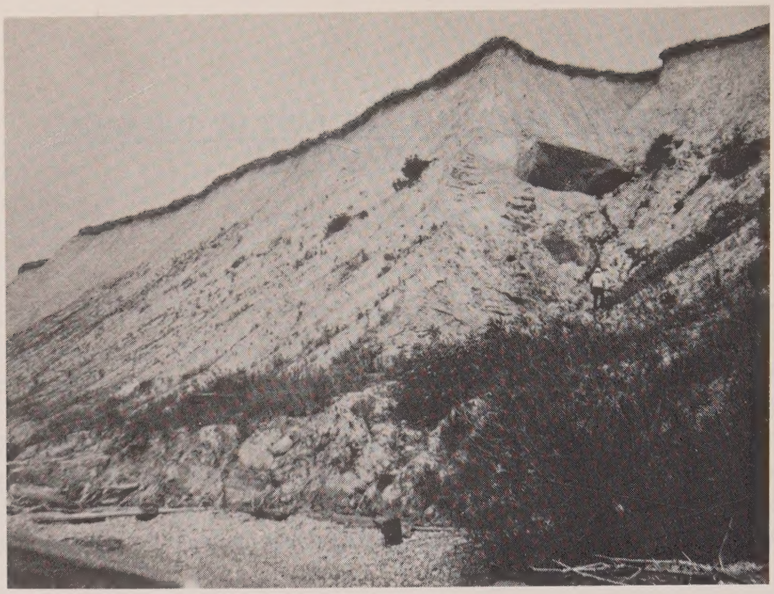

Figure 1. A small cave, created by groundwater discharge, in the upper right-hand portion of the picture marks the contact between glacial till over sand near the top of the bluff.

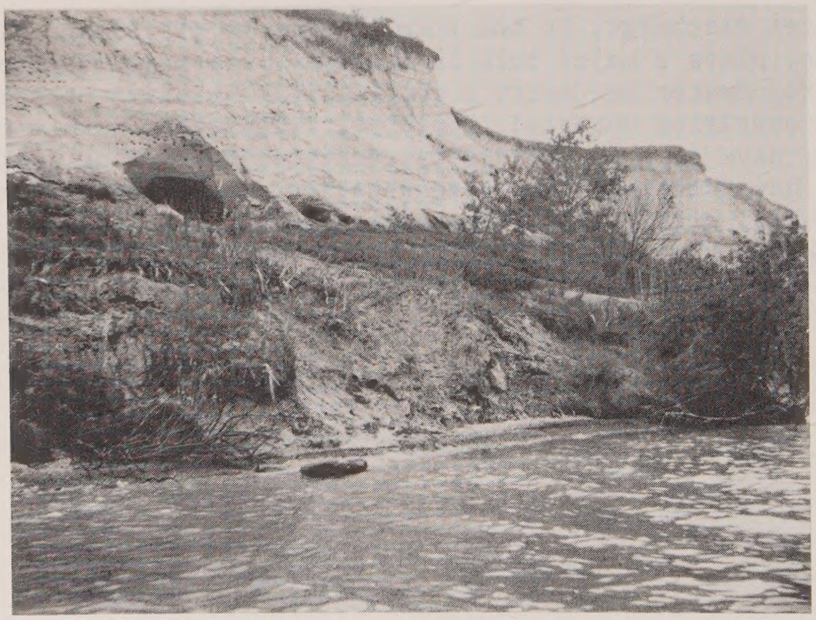

Figure 2. The upper limit of the vegetated slope roughly approximates the contact between sand and glacial till. Springs issuing at the base of the sand are marked by small caves. The upper limit of bird holes approximates the contact between the sand and overlying glacial till.

Figure 3. In the foreground a mudflow of liquified sand and silt has been created by springs issuing at the contact between sand and glacial till. Note the relatively dry appearance of the glacial till overlying the wet (dark) permeable beds. At the top of the bluff in the upper left-hand part of the picture, an ancient channel with sand and gravel fill is exposed.

Figure 4. *Landward erosion of the bluffs is indicated by the lower vegetated terrace of a large slump block created by groundwater erosion of the underlying material.*

Figure 5. *An early stage of an amphitheatre-like opening being developed in the bluffs.*

Figure 6. A sand ridge capped by glacial till and cut by a ravine separates an amphitheatre-like opening in the background from the shore.

ANALYSIS OF ENERGY FLUXES BY AERODYNAMIC METHODS

(IFYGL PROJECT 44 BL)

Data from the Canadian Meteorological Buoy Network have been employed to obtain a first estimate of the energy fluxes for Lake Ontario. The Lake Heffner and Hasse exchange coefficients are being used in the first estimates. Data have been employed as hourly averages for flux computations and these values then used to obtain daily fluxes for each of the buoy stations. Daily values for each station are then given a linear area weighting for obtaining a lakewide integrated flux which is then summed over weekly periods.

First estimates of fluxes for weekly periods from 19 April through 13 June, have been computed and provided to the Evaporation Synthesis Panel. Further computations have been carried out to 3 October and are soon to be provided to the Panel.

METEOROLOGICAL BUOY MEASUREMENTS

(IFYGL PROJECT 97 BL)

The primary portion of the Meteorological Buoy Measurements were terminated in mid-December. A summary of the data obtained from the system is shown in Figure 7. Number of possible data hours and hours of data actually obtained are given for each sensor at each station. An overall average of 91% of possible data were obtained. Data from all stations have been examined and are ready for verification. Verification has been completed for data through October and these data are available to the IFYGL Data Bank.

One buoy has been left at station mooring number 3 during the winter. A record change was accomplished in mid-February and performance seems normal. Heavy ice accumulation has not affected performance but the humidity sensor does not function properly at below freezing temperature. This mooring was maintained through the remainder of IFYGL. Data verification remains to be completed. Station 7 was re-installed 18 April. Both Stations 3 and 7 will will be continued through July 1973, for purposes of the Radiation Budget effort in 1973.

Floyd C. Elder

METEOROLOGICAL BUOY DATA FOR LAKE ONTARIO (IFYGL) 1972

STN.	POSSIBLE HRS DATA	RECORDED HRS DATA	% RETURN	
1 –	5952	5254	88.3	WIND SPEED
	5952	5254	88.3	WIND DIR
	5952	5254	88.3	AIR TEMP
	5952	5254	88.3	REL HUMID
	5952	5254	88.3	WATER TEMP
2 –	5732	5447	95.0	WIND SPEED
	5732	5455	95.2	WIND DIR
	5732	5455	95.2	AIR TEMP
	5732	5287	92.2	REL HUMID
	5732	5455	95.2	WATER TEMP
3 –	5811	5091	87.8	WIND SPEED
	5811	5102	87.8	WIND DIR
	5811	5102	87.8	AIR TEMP
	5811	5102	87.8	REL HUMID
	5811	5102	87.8	WATER TEMP
	5787	5078	87.8	SOLAR RAD
	3188	2504	78.5	PRESSURE
4 –	5756	5490	95.4	WIND SPEED
	5756	5490	95.4	WIND DIR
	5756	5495	95.5	AIR TEMP
	5756	5495	95.5	REL HUMID
	5756	5495	95.5	WATER TEMP
5 –	5854	5205	88.9	WIND SPEED
	5854	5283	90.2	WIND DIR
	5854	5205	88.9	AIR TEMP
	5854	4871	83.2	REL HUMID
	5854	5562	95.0	WATER TEMP
6 –	5783	5031	87.0	WIND SPEED
	5783	4834	83.6	WIND DIR
	5783	5040	87.2	AIR TEMP
	5783	4834	83.6	REL HUMID
	5783	5040	87.2	WATER TEMP
7 –	5639	5598	99.3	WIND SPEED
	5639	5639	100	WIND DIR
	5639	5639	100	AIR TEMP
	5639	5639	100	REL HUMID
	5639	5639	100	WATER TEMP
	5639	5077	90.0	SOLAR RAD
	3894	3894	100	PRESSURE
8 –	5447	5447	100	WIND SPEED
	5447	5447	100	WIND DIR
	5447	5447	100	AIR TEMP
	5447	4973	91.3	REL HUMID
	5447	5447	100	WATER TEMP
9 –	5597	4919	87.9	WIND SPEED
	5597	4980	89.0	WIND DIR
	5597	4980	89.0	AIR TEMP
	5597	4815	86.0	REL HUMID
	5597	4980	89.0	WATER TEMP
10 –	5590	4728	84.6	WIND SPEED
	5590	4728	84.6	WIND DIR
	5590	4728	84.6	AIR TEMP
	5590	4728	84.6	REL HUMID
	5590	4728	84.6	WATER TEMP
	1677	555	33.1	SOLAR RAD
	2834	2376	83.8	PRESSURE
11 –	5561	5522	99.3	WIND SPEED
	5561	5522	99.3	WIND DIR
	5561	5561	100	AIR TEMP
	5561	5561	100	REL HUMID
	5561	5561	100	WATER TEMP
	336,629	307,678	91.4	

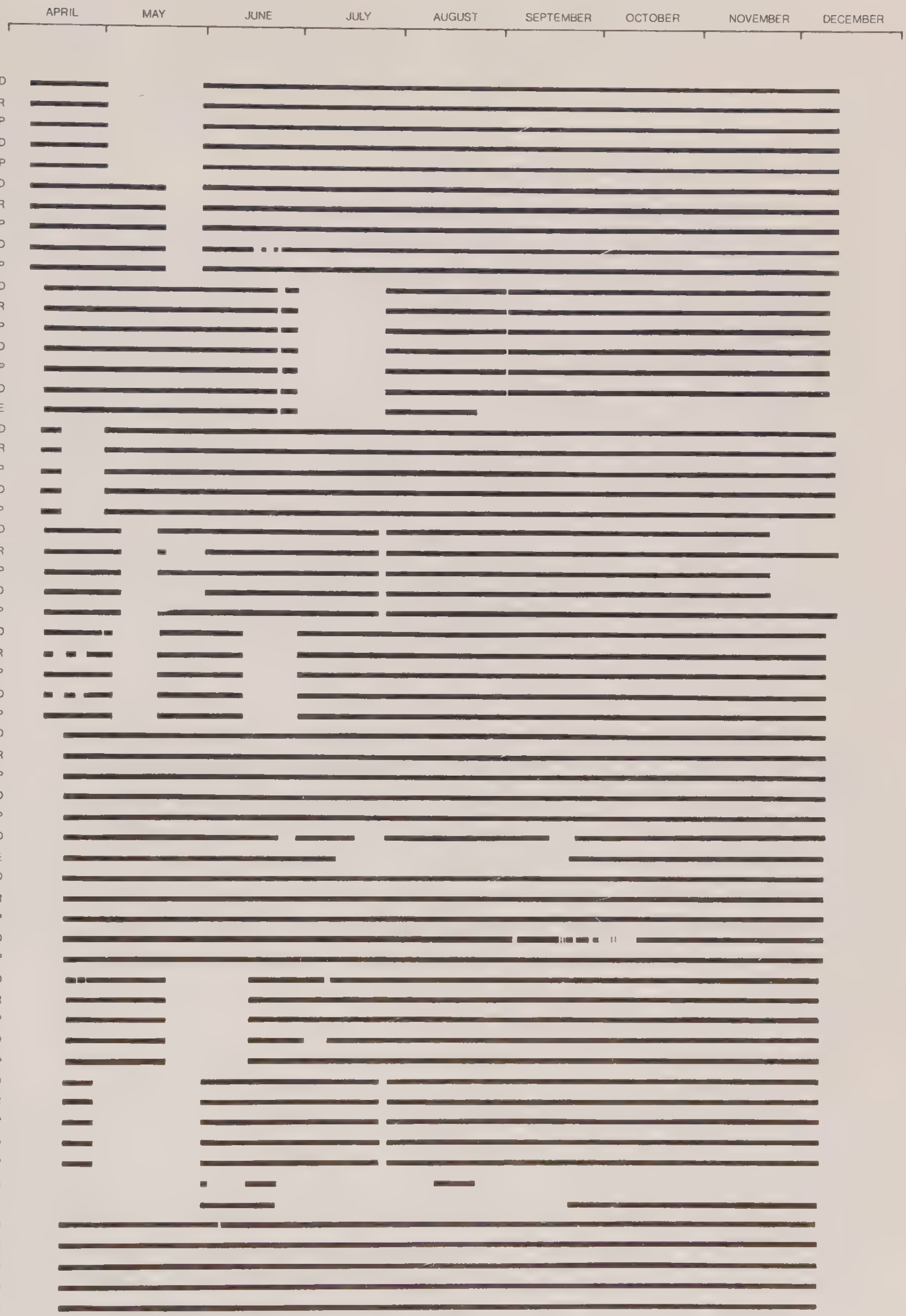

Figure 7.

DETERMINATION OF TEMPERATURE AND CURRENT CLIMATOLOGY RELEVANT TO COOLING WATER INTAKE LOCATIONS FOR THE PROPOSED ONTARIO HYDRO GENERATING STATIONS

(IFYGL PROJECT 110WM)

The Hydraulic Studies Department of Ontario Hydro participated in the IFYGL Program from mid-April to mid-November, 1972 by installing and operating a number of continuous recording current meters and temperature measuring instruments along Lake Ontario's north shore between Pickering and Lennox Generating Station sites. The objective of the program was to obtain information relating to water temperatures at depths varying from five to 70 feet and the magnitude and direction of lake currents. This information is essential for the design and optimum layout of cooling water systems for the proposed generating stations; and also for establishing the water environmental conditions prior to and after the plants become operational.

All temperature and current recording instruments were installed within 5,000 feet from the shore at Pickering, Bowmanville (Raby Head), Wesleyville (Chrysler Point), Chub Point, and Lennox. Locations of these instruments are shown in Figure 8. The depths and the periods of record are given in Table 1.

The in situ current temperature recorders used were Hydro Products Models 502 and 505 which recorded water temperature and current speed and direction every thirty minutes on a single chart. Other temperature recorders used were Rustrak recorders coupled with fast acting thermistor probes. Operational difficulties were encountered during the period of investigation but all efforts were made to keep the missing periods to a minimum and good records were acquired up to about 80% of the days the recording instruments were in service.

Preliminary Results

Nearly all data has been abstracted from the charts on hourly basis and transference of data to standard time series system is under way. Data in form of hourly values are being submitted to the Canadian Data Bank of IFYGL. Processing and analysis will be carried out as soon as checking and screening of raw data is completed. Preliminary indications, however, are that net transport at the three stations, Bowmanville, Wesleyville, and Chub Point approximately 18 to 20 miles apart was westward. The magnitude and direction of net transport was influenced by local topography and shoreline geometry, but the flow was predominantly longshore at all stations. Maximum and average current speeds were 1.0 ft per second (30 cm/s) and 0.33 ft/s, respectively, and are in close agreement with those observed a year earlier.

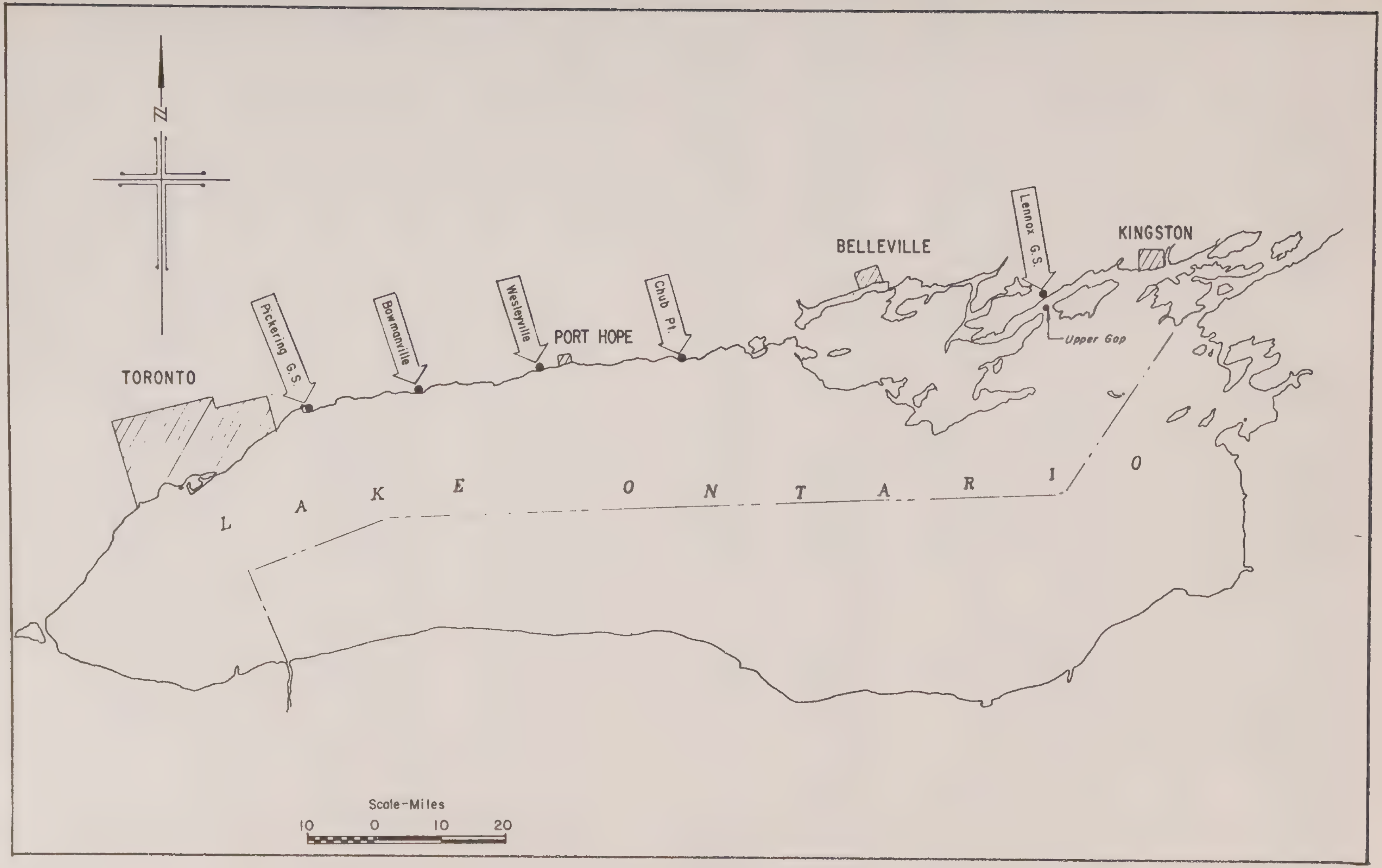

Figure 8. Recording locations for Ontario Hydro study of water temperatures and currents. Information gathered will be used for optimum layout of cooling water systems for proposed generating stations.

Further analysis will be directed to evaluate the effect of wind and other atmospheric variables. Temperature data at all depths will be analyzed and plotted to a common time scale to reveal spatial and seasonal temperature distribution.

Table 1. Depth and period of current meter measurements

Station	Depth (ft)	Parameter	1972
Chub Point	52	Temperature	Apr. 11 to Nov. 9
Chub Point	33	Temp., speed, direction	Apr. 15 to Nov. 23
Bowmanville	25	Temp., speed, direction	Apr. 14 to Dec. 7
Bowmanville	6	Temperature	June 6 to Nov. 8
Bowmanville	40	Temperature	Apr. 25 to Dec. 8
Bowmanville	70	Temperature	June 27 to Nov. 21
Wesleyville	25	Temperature	Apr. 14 to Nov. 22
Wesleyville	25	Speed, direction	Apr. 14 to July 1
Wesleyville	40	Temperature	May 19 to Nov. 22
Wesleyville	70	Temperature	July 11 to Nov. 22
Pickering	25	Temp. speed, direction	Apr. 24 to Dec. 5
Pickering West Limits	6	Temperature	May 25 to Sept. 30
Pickering	40	Temperature	Apr. 24 to Dec. 5
Lennox Upper Gap	50	Temp., speed, direction	May 19 to Oct. 28
Lennox North Channel	5	Temperature	May 9 to Nov. 10
Lennox North Channel	30	Temperature	May 9 to Nov. 10
Lennox North Channel	84	Temperature	June 13 to Nov. 10

A. A. Arajs

A.R.T. SURVEYS OF LAKE ONTARIO SUMMARY OF FLIGHT OPERATIONS

(IFYGL PROJECT 16ME)

Introduction

Canadian IFYGL Project 16ME was undertaken by the Lakes and Marine Applications section of Hydrometeorology Division, Meteorological Applications Branch, Atmospheric Environment Service, Canada Department of the Environment.

The objective of the project was to obtain surface water temperature data from Lake Ontario at approximately weekly intervals by means of Airborne Radiation Thermometer (A.R.T.) surveys.

Instrumentation consisted of a Barnes Engineering model PRT-5-radiometer operating in the 8 to 14 micron region, and a Honeywell model Electronik 19 strip chart recorder. The surveys were flown in an Aztec C aircraft under charter from Toronto Airways Limited based at Buttonville, Ontario.

The project was started in January 1972, and completed in March 1973. A.R.T. survey flights were scheduled for the first working day of each week; additional flights were attempted during IFYGL alert periods in June and October of 1972.

Operational Performance

Completion of the proposed flight schedule depended on two factors - weather conditions and serviceability of equipment. The minimum weather conditions required were: ceiling 500 feet, visibility four miles, and no fog or precipitation below the aircraft. Serviceability of equipment included proper functioning of the instruments and availability of aircraft and crew.

In order to evaluate to what extent bad weather and unserviceable equipment hindered A.R.T. flight operations, a tabulation of the daily weather conditions, flight scheduling and flight cancellations has been made for the January 1, 1972 to March 31, 1973 period. The abbreviations and symbols used in the analysis are explained in the section preceding the tabulations.

Summary of Weather Conditions

During the period January 1, 1972 to March 31, 1973 there were:

Number of working days	315	
Working days with good weather	131	(42%)
Working days with marginal weather	65	(21%)

Assuming that a survey flight could have been completed on half of the days with marginal weather condtions, then about half of the total available working days had weather suitable for flying.

More significant figures on weather conditions are obtained by looking at three month intervals (see Table 2).

Table 2. Trimonthly breakdown of weather conditions. Percentage of total working days given in parenthesis

	January - March 1972	April - June 1972	July - September 1972	October - December 1972	January - March 1973
Number of working days	63	63	63	61	65
Working days with good weather	22(35)	31(49)	39(62)	20(33)	20(31)
Working days with marginal weather	18(28)	14(22)	8(13)	11(18)	14(22)

Assuming that flights could be completed on 50% of the marginal days, the portion of working days in each quarter on which surveys could have been made were:

January - March, 1972	49%
April - June 1972	60%
July - September 1972	69%
October - December 1972	42%
January - March 1972	42%

The worst month in the history of the Atmospheric Environment Service ART program was December 1972. Only one working day was "operational" and only 4 more were "marginal". This gives a fraction of only 16%. The three month period November 1972 to January 1973 provided only a 29% opportunity.

Flight Record (January 1, 1972 - March 31, 1973)

Flight Operations

Scheduled flights	71
Attempted flights	70
Completed flights	51 (72% of scheduled)
Partial flights (40% - 80% coverage)	10 (14% of scheduled)

Flight Postponements

Flights completed as scheduled	31 (3 partial)
Postponements due to weather	73
Postponements due to adverse modification of atmosphere by lake	20
Postponements due to unserviceable equipment	8

Explanation of symbols and abbreviations used in Table 3.

Weather	0	operational
	X	unsuitable
	M	marginal
Flight Record	N	Saturday, Sunday or holiday
	1	flight number. If no modifier follows, the flight was completed on that day. The first modifier may be:

D = delayed
A = aborted, less than 40% complete
P = partial coverage - more than 40%

The second modifier may be:

W = weather
L = lake effect - fog, etc.
E = equipment failure

e.g.
7AL - flight 7 aborted due to lake effect
15PE - flight 15 partial only due to equipment failure
22DW - flight 22 delayed due to weather

Table 3. Canadian IFYGL Project 16ME, A.R.T. Survey Flight Record

	JANUARY 1972		FEBRUARY 1972		MARCH 1972	
DATE	WEATHER	FLIGHT RECORD	WEATHER	FLIGHT RECORD	WEATHER	FLIGHT RECORD
1	0	N	0	6DL	X	
2	X	N	M	6	X	
3	M	N	X		M	
4	X	1DW	X		M	N
5	M	1PW	0	N	X	N
6	M		X	N	M	11
7	X		0	7DL	M	
8	M	N	0	7AL	0	
9	X	N	M	7DW	M	
10	M	2	M	7DW	M	
11	0		M	7PE	0	N
12	0		X	N	0	N
13	M		X	N	0	12
14	0		X	.8DW	X	
15	0	N	X	8DW	X	
16	M	N	M	8	X	
17	X	3DW	0		X	
18	0	3	X		M	N
19	0		X	N	0	N
20	X		X	N	0	13
21	M		0	9	0	
22	X	N	M		X	
23	0	N	M		X	
24	0	4	X		X	
25	X		0		M	N
26	0		M	N	0	N
27	0		0	N	0	14
28	X		M	10	0	
29	0	N	X		0	
30	X	N			X	
31	0	5PL			0	N
Working days	20		21		22	
With Good Weather	9		6		7	
With Marginal Weather	5		8		5	
Flights: Scheduled		5		5		4
Attempted		5		6		4
Completed		3		4		4
Partial		2		1		0
Postponements due to:						
Weather		2		4		0
Lake Effect		0		3		0
Equipment U/S		0		0		0

Table 3. Canadian IFYGL Project 16ME, A.R.T. Survey Flight Record (Continued)

	APRIL 1972		MAY 1972		JUNE 1972	
DATE	WEATHER	FLIGHT RECORD	WEATHER	FLIGHT RECORD	WEATHER	FLIGHT RECORD
1	M	N	M	20	X	
2	0	N	X		M	
3	0	N	0		M	N
4	X	15DW	X		0	N
5	M	15DW	0		0	24
6	X	15DW	X	N	M	
7	0	15PE	M	N	0	25
8	M	N	M	21DW	M	
9	0	N	0	21	0	
10	0	16DE	0		0	N
11	M	16PW	0		0	N
12	M	17	0		M	26
13	X		0	N	0	
14	0		X	N	X	
15	X	N	X	22DW	0	
16	X	N	X	22DW	0	
17	0	18	X	22DW	0	N
18	M		X	22DW	0	N
19	X		0	22DW	0	27DL
20	M		M	N	0	27DL
21	0		M	N	X	27DW
22	X	N	0	N	X	27DW
23	M	N	0	22	M	27DW
24	M	19DW	0		X	N
25	0	19	0		X	N
26	0		0		M	27DW
27	0		0	N	0	27
28	0		0	N	0	
29	0	N	0	23	X	
30	0	N	X		X	
31			X			
Working days	19		22		22	
With Good Weather	9		12		10	
With Marginal Weather	6		2		6	
Flights: Scheduled		5		5		5
Attempted		5		4		4
Completed		3		4		4
Partial		2		0		0
Postponements due to:						
Weather		4		5		4
Lake Effect		0		1		2
Equipment U/S		1		0		0

Table 3. Canadian IFYGL Project 16ME, A.R.T. Survey Flight Record (Continued)

DATE	JULY 1972		AUGUST 1972		SEPTEMBER 1972	
	WEATHER	FLIGHT RECORD	WEATHER	FLIGHT RECORD	WEATHER	FLIGHT RECORD
1	0	N	0		X	
2	0	N	X		X	N
3	X	28DW	X		X	N
4	0	28	0		0	N
5	0		0	N	0	34DL
6	0		0	N	0	34
7	0		X	N	0	
8	0	N	0	31	X	
9	M	N	0		0	N
10	M	29AL	0		0	N
11	0	29DL	0		0	35
12	X	29DW	X	N	0	
13	X	29DW	M	N	X	
14	X	29DW	X	32DW	M	
15	X	N	0	32DL	0	
16	M	N	0	32DL	0	N
17	M	29AL	X	32DL	0	N
18	0	29DL	M	32	M	36DW
19	0	29DL	0	N	X	36DW
20	0	29DL	0	N	0	36DE
21	0	29DL	0		0	36
22	0	N	X	33DW	0	
23	0	N	X	33DW	0	N
24	0	29	X	33DW	X	N
25	M		M	33DW	X	37DW
26	0		0	N	X	37DW
27	0		M	N	0	37DE
28	0		0	33DL	0	37
29	0	N	0	33DL	M	
30	0	N	0	33	X	N
31	0	30	0			
Working days	21		22		20	
With Good Weather	14		13		11	
With Marginal Weather	3		2		3	
Flights: Scheduled		5		4		4
Attempted		5		3		4
Completed		3		3		4
Partial		0		0		0
Postponements due to:						
Weather		4		6		4
Lake Effect		7		4		1
Equipment U/S		0		0		2

Table 3. Canadian IFYGL Project 16ME, A.R.T. Survey Flight Record (Continued)

DATE	OCTOBER 1972		NOVEMBER 1972		DECEMBER 1972	
	WEATHER	FLIGHT RECORD	WEATHER	FLIGHT RECORD	WEATHER	FLIGHT RECORD
1	0	N	0		X	
2	0	38	X		X	N
3	X		M		X	N
4	0		X	N	X	48DW
5	0	39	0	N	X	48DW
6	X		M	44	X	48DW
7	X	N	M		M	48DW
8	M	N	X		X	48DW
9	0	N	X		X	N
10	0	40	X		X	N
11	0		X	N	M	48
12	X		0	N	X	
13	0	41DE	0	N	0	
14	X	N	X	45DW	M	
15	0	N	0	45DE	X	
16	M	41DE	0	45	X	N
17	0	41DE	X		0	N
18	0	41	X	N	X	49DW
19	0		X	N	X	49DW
20	0		X	46DW	X	49DW
21	0	N	M	46	X	49DW
22	X	N	X		X	49DW
23	X	42DW	X		X	N
24	X	42DW	0		X	N
25	0	42	X	N	X	N
26	0		X	N	X	N
27	X		X	47DW	M	49PW
28	X	N	M	47PW	X	50DW
29	X	N	0		X	50AW
30	0	43	M		X	N
31	0				X	N
Working days	21		21		19	
With Good Weather	14		5		1	
With Marginal Weather	1		6		4	
Flights: Scheduled		7		4		4
Attempted		6		4		3
Completed		6		3		1
Partial		0		1		1
Postponements due to:						
Weather		2		3		12
Lake Effect		0		0		0
Equipment U/S		3		1		0

Table 3. Canadian IFYGL Project 16ME A.R.T. Survey Flight Record (Continued)

	JANUARY 1973		FEBRUARY 1973		MARCH 1973	
DATE	WEATHER	FLIGHT RECORD	WEATHER	FLIGHT RECORD	WEATHER	FLIGHT RECORD
1	M	N	X		0	57DL
2	M	50PW	X		X	57DW
3	0		M	N	X	N
4	X		X	N	X	N
5	X		0	54	M	57DW
6	0	N	0		X	57DW
7	M	N	X		M	57DW
8	M	51AW	X		0	57PE
9	X	51DW	M		0	58
10	M	51AW	M	N	X	N
11	X	51DW	M	N	X	N
12	M	51AW	X	55DW	0	
13	0	N	0	55	0	59DE
14	X	N	0		X	59DW
15	M	51AW	X		X	59DW
16	X	51DW	X		0	59
17	0	51	0	N	X	N
18	0		0	N	X	N
19	X		X	56DW	M	
20	X	N	X	56DW	M	60
21	0	N	X	56DW	M	
22	X	52DW	X	56DW	M	
23	X	52DW	0	56	0	
24	X	52DW	M	N	0	N
25	0	52	0	N	0	N
26	X		M		0	61
27	X	N	X	57DW	0	
28	X	N	0	57AL	0	
29	X	53DW			X	
30	M	53PW			X	
31	X				X	
Working days	22		20		23	
With Good Weather	4		6		10	
With Marginal Weather	6		2		6	
Flights: Scheduled		5		4		5
Attempted		8		4		5
Completed		2		3		4
Partial		2		0		1
Postponements due to:						
Weather		11		6		6
Lake Effect		0		1		1
Equipment U/S		0		0		1

BATHYMETRIC SURVEY OF LAKE ONTARIO AND POSITIONING SYSTEM EVALUATION

(IFYGL PROJECT 79F)

Our primary objectives since the commencement of the Field Year study early in April 1972 were:

(a) to mobilize, calibrate and evaluate extensively the DECCA LAMBDA (6f) positioning system in a fresh water environment,

(b) to carry out a metricated bathymetric survey of Lake Ontario in the offshore area beyond the coastal confluence, i.e., the thirty meter contour.

I am pleased to make it known that objectives have been fulfilled and the projects completed to my satisfaction.

Positioning System Evaluation

Specifically, the positioning system evaluation was, in my opinion and that of COMDEV MARINE, the lessor, wholly successful and results obtained much better than we had mathematically predicted. In summary, "Phase Lag" effect was measured during five (5) cruises and monitoring exercises under varying meteorological, lake and land path conditions. Our estimated Velocity of Propagation of 299,400 km/s proved through measurements taken in the field to be 299,410 km/s, a negligible difference of 10 km/s at ranges approaching three hundred kilometers. Calculated error, after applying corrections for specific conductance, temperature, etc. amounts to two one-hundredths (0.02) of a lane.

The study has proved that a theoretical model is reliable and can be used for prediction of electromagnetic wave velocities in other and comparable freshwater lakes.

Bathymetry

Project instructions and objectives for the charting survey of Lake Ontario have been adequately described and appear in a number of existing IFYGL Bulletins and Quarterly Reports, and in the Technical Plan.

Five cruises comprising some 6100 (plus) n.m. of data collecting over a period of 47½ working days were required to complete this project. All equipment was mobilized aboard, and the respective surveys carried out from the CSS Limnos and Advent. Postion determination was accomplished exclusively by use of the DECCA positioning system.

Collecting and processing of bathymetry and position data was entirely automated except for the Advent cruise by making full use of the recently developed "Hydrographic Acquisitioning and Processing System" (HAAPS).

The fifth and final bathymetric cruise was carried out during the period May 22 - 27 inclusive, operating from the newly commissioned CSS "Advent".

This portion of the charting project was carried out specifically for the geolimnology group, CCIW in the Rochester area* at an enlarged scale of 1:80 000 to better delineate and more accurately contour the bottom topography in a very complex area.

The data obtained is presently being automatically portrayed on a polyconic projection; completion date is scheduled for mid-June.

This completes our contribution to Project 79F.

Statistics for this cruise #73

Operational days	6
Man days (Hydrographic)	12 (2 staff)
Total mileage steamed	570 n.m.
Total mileage, data	306 n.m.
Fuel consumed	1700 gal., diesel fuel

Total statistics for the project

Total mileage, data	6106 n.m.
Total man days	213½ (.6 + man years)

Logistics

1. Scheduled DECCA chain downtimes as listed below have been adhered to:

    (a) 0001 hours, 7 April to 2359, 22 April

    (b) 0001 hours, 5 May to 2359, 20 May

2. Reference buoys were retrieved in mid-May.

3. Bathymetric field manuscripts have been completed and submitted with the exception of the 1:80 000 F.S. of Rochester Basin, a special project.

---

*The deepest point in Lake Ontario was found to be 247 meters (135 fathoms) as opposed to that depth shown on the chart of 243 meters (133 fathoms).

4. All data pertaining to bathymetry and positioning will be stored in the IFYGL Data Bank, Canada Centre for Inland Waters, P.O. Box 5050, Burlington, Ontario, L7R 4A6.

ANNOUNCEMENT

For those not already informed, the directorate has, of March 31, 1973 purchased the DECCA positioning system.

The DECCA LAMBDA (6f) positioning system will discontinue operation as of 15th June. Shortly thereafter the chain will be demobilized and stored at C.C.I.W. for future use on programmed offshore major survey projects.

All reports, written and oral, indicate complete satisfaction with the system which was efficiently operated on all occasions. Accuracy evaluations have proven to be most satisfactory.

F. L. DeGrasse

WIND TEMPERATURE AND HUMIDITY FLUCTUATIONS

(IFYGL PROJECT 75BL)

Progress Report, March 1973

During this quarter final analysis of the first two data sets (September 26 to October 14, 1971 and June 16 to 21, 1972) at the Niagara Bar boundary layer study site was computed. Good agreement between a thrust anemometer and a sonic anemometer was obtained. Eddy fluxes of momentum, heat and water vapour at wind speeds from 3 to 10 m/s and in near-neutral atmospheric stability can be described by bulk aerodynamic coefficients:

$$C_{10} = C_T = C_Q = 1.2 \times 10^{-3}$$

These values are similar to those published in the literature for other bodies of water. A detailed report has been prepared for submission to 'Boundary Layer Meteorology'.

Preliminary analysis of results from Bedford Buoy 'A' (October 4 - 12, 1972) gives generally similar but less consistent results. Evaporation measurements were not attempted in this experiment. A preliminary data sheet is shown in Table 4, but examination of the effects of buoy motion and tilt will be necessary and may result in rejection of some of the data.

Turbulence spectra and cospectra for specific data runs are available from S. D. Smith and E. G. Banke, Air-Sea Interaction, Atlantic Oceanographic Laboratory, Bedford Institute of Oceanography, Dartmouth, Nova Scotia, Canada.

S. D. Smith and E. G. Banke

Table 4. Preliminary Data, Project 75BL, October 1972. Location: Bedford Buoy 'A' off Port Credit, Lake Ontario (43° 28' 42" N, 79° 3' 36" W). Sensor: Sonic Anemometer, Height 12.8m

Start Time GMT	Day Oct. 1972	Duration (min.)	Mean Wind U_{10} (m/s)	Mean Products $\langle u_1u_3\rangle$ $(m/s)^2$	$\langle u_1u_2\rangle$ $(m/s)^2$	$\langle u_2u_3\rangle$ $(m/s)^2$	$\langle u^2u_3\rangle$ $(m/s)^3$
1330	4	44	4.60	-.025	-.056	0.007	0.002
1828	4	36	4.88	-.012	-.015	0.001	0.003
2307	4	44	6.08	-.034	0.025	0.003	0.011
0438	11	31	4.96	-.025	-.029	0.002	0.100
1027	11	44	4.74	-.031	-.079	0.010	0.208
1435	11	44	3.26	-.015	-.060	0.002	0.002
1745	11	44	5.88	-.019	-.080	0.008	-.011
1948	11	44	8.09	-.041	0.001	0.003	-.009
0210	12	44	8.35	-.019	0.019	0.012	0.007
0707	12	30	6.10	-.028	-.054	0.011	0.174
Mean			5.69				
Std. Dev'n.							

Table 4. Preliminary Data, Project 75BL, October 1972 (Continued)

Turbulence Levels							
σ_1/U	σ_2/U	σ_3/U	$\sigma_3/u*$	$\frac{\langle U^2 u3\rangle}{2Uu*^2}$	$\langle tu3\rangle$ (deg. m/s)	Tilt θv	Drag Coef. $10^3 C_{10}$
0.074	0.087	0.041	1.21	0.010	-.0003	12.54	1.19
0.060	0.045	0.030	1.36	0.021	-.0003	6.08	0.51
0.072	0.047	0.037	1.25	0.027	-.0024	8.87	0.92
0.091	0.083	0.054	1.74	0.402	0.0184	5.93	1.00
0.119	0.116	0.044	1.22	0.692	0.0083	4.86	1.38
0.117	0.097	0.049	1.33	0.018	0.0041	4.75	1.42
0.092	0.071	0.047	2.04	-.048	-.0029	5.51	0.54
0.068	0.055	0.042	1.71	-.014	-.0063	7.44	0.63
0.069	0.052	0.034	2.07	0.022	-.0049	8.87	0.28
0.106	0.100	0.057	2.06	0.506	0.0287	4.58	0.75
Mean							0.86
Std. Dev'n.							0.39

Table 4. Preliminary Data, Project 75BL, October 1972 (Continued)

Comment	A.E.S. Data				
	Wind (m/s)	from (deg.)	Air Temp. (°C)	Dew Pt. (°C)	Water (°C)
	4.8	95	-	-	-
	5.2	63	-	-	-
	6.5	51	-	-	-
N	4.9	123	10.2	-	13.3
VN	4.9	176	11.2	-	13.2
N	3.2	159	12.3	-	13.2
	6.5	181	14.2	10.2	13.5
	9.0	192	15.1	10.7	13.4
	8.5	212	15.2	12.3	13.2
N	6.9	218	14.7	13.7	13.2

Note: Results not corrected for motion of buoy; less reliable than results from Niagara Bar experiments.

COMMENTS: N Horizontal wind signals noisy

VN Horizontal wind signals very noisy

COORDINATOR'S NOTES

Four additional cruise plans were filed with the IFYGL Centre since the issue of Bulletin 6, bringing the total at the end of the data gathering phase of IFYGL to 94. The ninth and final OOPS cruise was carried out by the Martin Karlsen in the two weeks, March 5 - 9, and March 12 - 17, 1973. The Heat Content and Surface Eutrophication study was also completed for the Field Year with three cruises on February 26 - March 1, March 12 - 14, and March 26 - 28, 1973. The Limnos monitored several additional stations on the February 26 - March 1 cruise as the Porte Dauphine was still unable to operate. An additional Waverider Buoy was also retrieved at this time as it had ceased to operate.

Project List

The following are recent changes to the Project List given in Appendix I, Bulletin 2. Earlier changes have been given in previous Bulletins. More information on these projects together with Progress Reports provided by the Project Leaders can be found in Canadian Projects and Canadian Projects, Supplements 1, 2 and 3, available from the Canadian IFYGL Centre, Canada Centre for Inland Waters, P.O. Box 5050, Burlington, Ontario, L7R 4A6.

51EB	Withdrawn
79F	Completed (See report this issue)
114WM	Included in 89WM
94	Completed. Final Report - Data Retransmission via Satellite was submitted to the Canadian IFYGL Data Bank April 26, 1973.
85BC, 104BC	M. T. Shiomi is no longer Project Leader. His replacement has not yet been named.

IAGLR IFYGL SYMPOSIUM

The 16th IAGLR Conference was held at Huron, Ohio, from April 16 to April 18. During this conference an IFYGL Symposium was held on April 17. A total of 21 papers were presented at this Symposium, 12 of which were Canadian. These papers were concerned with both the technical operation of the equipment used to collect the data and preliminary results.

The following is a list of the Canadian papers that were presented and the people who presented them.

ASPECTS OF THE NATURE OF MID-LAKE CURRENTS OBSERVED IN LAKE ONTARIO DURING 1972. E. B. Bennett, Canada Centre for Inland Waters, Burlington, Ontario (IFYGL Project 45WM)

DATA QUALITY AT THE ATMOSPHERIC ENVIRONMENT SERVICE LAKE STATIONS DURING IFYGL D. H. Champ, Atmospheric Environment Service, Downsview, Ontario. (IFYGL Project 21ME)

SPRING THERMOCLINE BEHAVIOUR IN LAKE ONTARIO DURING IFYGL. G. T. Csanady, University of Waterloo, Waterloo, Ontario. (IFYGL Project 40WM)

A PRELIMINARY INVESTIGATION OF THE WIND STRESS FIELD OVER LAKE ONTARIO. P. F. Hamblin and F. C. Elder, Canada Centre for Inland Waters, Burlington, Ontario. (IFYGL Project 44BL)

AN EXPERIMENTAL STUDY OF DIFFUSION CHARACTERISTICS IN THE THERMOCLINE AND HYPOLIMNION REGIONS OF LAKE ONTARIO. G. Kullenberg, University of Copenhagen, Denmark, C. R. Murthy, Canada Centre for Inland Waters, Burlington, Ontario, and H. Westerberg, University of Goteborg, Sweden. (IFYGL Project 89WM)

LATENT AND SENSIBLE HEAT FLUXES OVER LAKE ONTARIO. H. Martin, Atmospheric Environment Service, Downsview, Ontario. (IFYGL Project 28BL)

GROUND WATER CHEMISTRY IN THE FORTY MILE CREEK DRAINAGE BASIN ON THE SOUTH SHORE OF LAKE ONTARIO. R. C. Ostry and N. D. Warry, Water Quantity Management Branch, Ontario Ministry of the Environment, Toronto. (IFYGL Project 38TW)

VERIFICATION OF NUMERICAL MODELS OF LAKE ONTARIO. T. J. Simons, Canada Centre for Inland Waters, Burlington, Ontario. (IFYGL Project 95WM)

SURFICIAL GEOLOGY ALONG THE NORTH SHORE OF LAKE ONTARIO IN THE BOWMANVILLE-NEWCASTLE AREA. S. N. Singer, Water Quantity Management Branch, Ontario Ministry of the Environment, Toronto. (IFYGL Project 38TW)

PRIMARY PRODUCTION MEASUREMENT USING THE C^{14} TECHNIQUE IN SITU AT AN INSHORE AND OFFSHORE STATION IN LAKE ONTARIO, 1972-73. P. Stadelmann and J. E. Moore, Canada Centre for Inland Waters, Burlington, Ontario. (IFYGL Project 101BC)

REMOTE SENSING AND ITS APPLICATION TO THE STUDY OF THE GREAT LAKES. K. P. B. Thomson, Canada Centre for Inland Waters, Burlington, Ontario. (IFYGL Project 1F)

A PRELIMINARY LAKE ONTARIO WATER BALANCE DURING IFYGL. D. F. Witherspoon, Inland Waters Directorate, Department of the Environment, (IFYGL Project 11TW) and B. G. DeCooke, Detroit District, Corps of Engineers, Detroit.

PUBLICATION POLICY

The following is a copy of a letter recently distributed to the Canadian Project Leaders by Mr. T. L. Richards, Canadian Co-chairman, IFYGL Steering Committee and Management Team, to refresh the participants memories concerning the IFYGL Publication Policy.

IFYGL Reports and Scientific Papers

With the termination of the IFYGL data collection period we have now proceeded into the data analysis phase and the writing of reports and scientific papers. Although there will be an official series of IFYGL reports dealing with the major components of the Field Year the IFYGL Steering Committee and Management Team wish to remind scientists that they are encouraged to publish their individual results in appropriate scientific journals. The only proviso is that the paper contains a recognition of the fact that it is related to an IFYGL project. The official Field Year publication policy outlines the following acknowledgement procedure:

Acknowledgement

Each Report should include the following material in order to acknowledge the relationship of the Report to the Field Year program:

1. That the study was undertaken as part of the International Field Year for the Great Lakes, a Joint U.S.-Canadian (or Canadian-U.S.) contribution to the International Hydrological Decade program.

2. The relationship of the study and report to the overall IFYGL program and to the major components thereof.

3. Source of logistic support and assistance.

4. Source of funding as appropriate.

Wherever possible, the IFYGL symbol should be used on the cover, maps or figures to emphasize the cooperative nature of the IFYCL program.

It is important that each of these IFYGL-related papers becomes part of the official IFYGL inventory, (the Data Index). To this end would you please:

(i) Forward to Mr. T. L. Richards at least one copy (several, if possible) of all published papers or reports that in any way deal with the Field Year program, i.e. planning, feasibility studies, "first-look" and/or final reports or papers.

(ii) If no reprints are available, please forward an adequate reference.

Since we are most anxious that none of these individual reports be overlooked, would you please give this request your highest priority and continue to keep it in mind throughout the remainder of the report and paper writing phase of IFYGL.

UNITED STATES

Editors	Fred Jenkins and May Laughrun
Editorial assistance and typing	Patricia Mentzer

COMMENTS BY THE U.S. DIRECTOR

This issue covers activities during the fourth quarter of IFYGL, January 1 to March 31, 1973 (see fig. 1). Some reports on events in April and May 1973 are included.

At the 11th Meeting of the Joint Management Team on February 22, 1973, it was agreed that a few data collection systems would continue to operate beyond the Field Year to support the chemical-biological and energy balance programs. As a result, two additional lake-scale cruises are planned for April and June, and selected surface meteorological observation systems, e.g., automatic stations, radiation sensors, and evaporation pans, will be used for data collection through June 1973.

An estimate of the magnitude of the field observations between April 1, 1972, and March 31, 1973, is given in table 1. The more than 100 million lake, atmosphere, and basin observations shown in this table, which does not include all the IFYGL data collection systems, reflect a major accomplishment. With the end of the Field Year, although limited spring operations continue, the emphasis clearly shifts to the data management phase. The data management and archiving task we now face is a formidable one, and a long one, and all possible resources will be brought to bear on its successful completion. Work is progressing on preliminary processing of the ship, rawinsonde, and buoy, tower, and land station data. Provisional samples of all these data types should become available during the next quarter. Data requests from U.S. IFYGL participants should continue to be filed with the U.S. Data Manager, Dave Drury, D22, CEDDA, EDS, NOAA, U.S. Department of Commerce, Page Building 2, Washington, D.C. 20235.

Other highlights:

The first IFYGL Symposium was held as part of the Sixteenth Conference on Great Lakes Research of the International Association of Great Lakes Research (IAGLR), Huron, Ohio, April 16-18, 1973. Twenty-one United States and Canadian papers were presented. These included preliminary analyses of natural variability, verification of numerical models of Lake Ontario, and reports on the operations of some of the major U.S. data collection systems.

A Second IFYGL Symposium is planned. The Joint Management Team obtained approval from the Board of Directors of IAGLR to hold the symposium as part of the Seventeenth Conference on Great Lakes Research at McMaster University, Hamilton, Ontario, August 12-14, 1974. An estimated 120 papers will be presented. The IAGLR Board has agreed in principle to publish the conference proceedings in two parts, one covering the IFYGL Symposium. All papers for the proceedings must be submitted in manuscript form to IAGLR by May 1, 1974. Complete manuscripts, rather than abstracts, will be given preference for oral presentation at the Seventeenth Conference. Those not selected for presentation will be read by title and, if accepted, published in the proceedings.

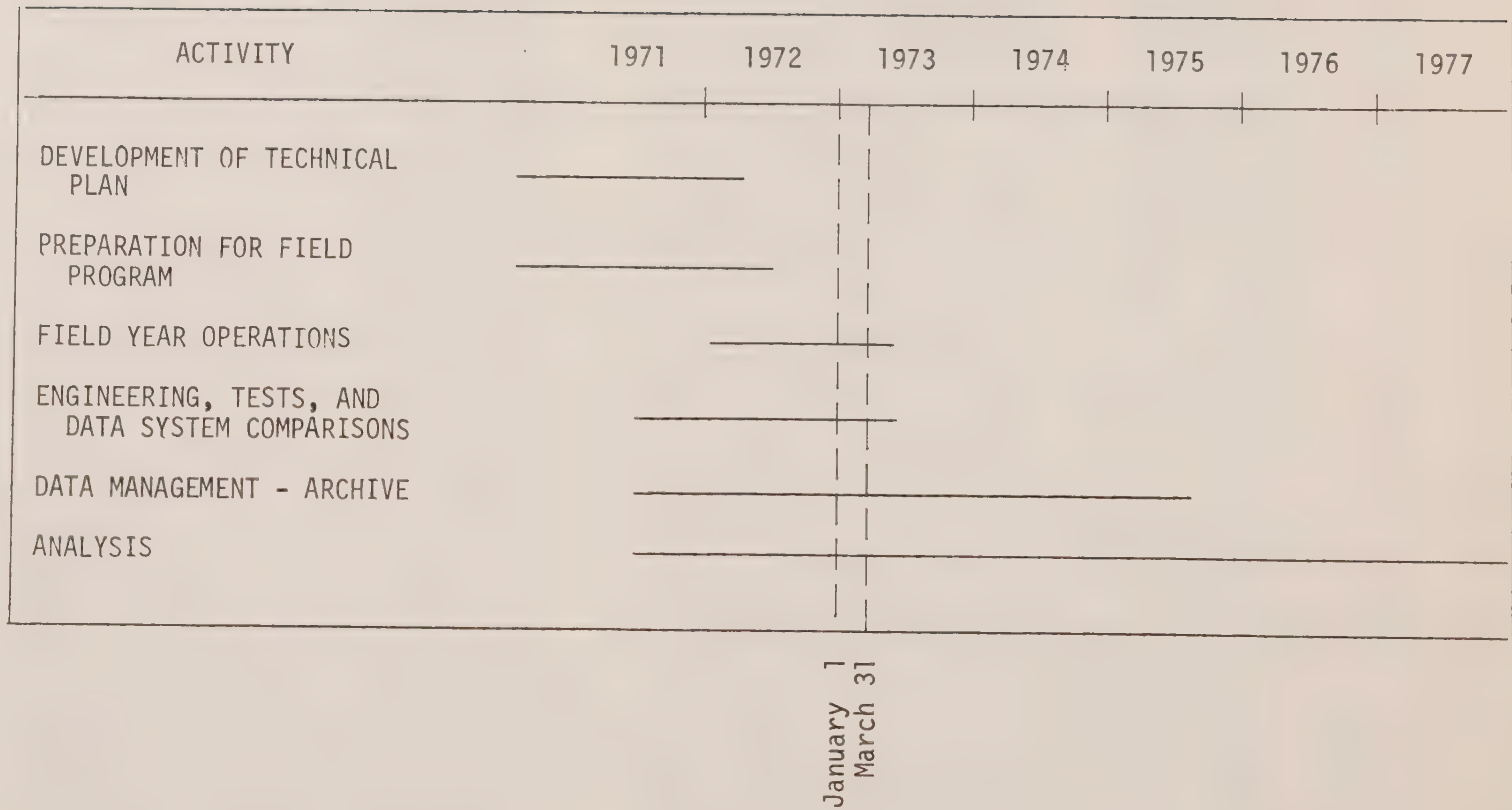

Figure 1. U.S. IFYGL schedule.

Table 1. Magnitude of IFYGL data collection

Observation systems and types of data	No. of observations
Buoys and towers: water currents, water temperature, air temperature, dew point, wind, pressure, radiation, precipitation	50×10^6
Automatic meteorological stations: wind, temperature, dew point, radiation, pressure, precipitation	8×10^6
Radar and precipitation networks	30×10^6
Rawinsonde soundings	2,000
Ships: BT, O_2 soundings	5,000
surface meteorological data, water temperature	3×10^6
water samples (nutrients, heavy metals, chemicals)	4×10^6
biological (chlorophyll, zooplankton, biomass, phytoplankton, particle count, fish)	10^4
Aircraft: wind , air temperature, pressure, dew point, humidity, vertical fluxes, solar radiation, lake surface temperature, gamma radiation, multispectral radiation	1.3×10^6
Basin hydrologic stations: stream gages, wells, soil moisture probes, snow courses, etc.	2.6×10^6
Lake hydrologic stations: water levels, water temperature, precipitation	1.1×10^6

Preparation of reports on the U.S. ship, rawinsonde, TI, radar, and aircraft data collection systems has begun. These will probably be published as part of the Technical Manual Series. Papers on the first three of the five systems were presented at the First IFYGL Symposium.

At the request of the Joint Steering Committee at its 30th meeting on April 12, 1973, action has been taken by the U.S. IFYGL Project Office to ensure that all IFYGL publications (The IFYGL Bulletin, Technical Manuals and Scientific Reports) be available through the National Technical Information Service (NTIS). This was done because several IFYGL Technical Manuals are now out of print. NTIS provides hard copies or microfiche, the latter at a cost of $1.45 per publication. Price of hard copy depends on the length of the document. The address is:

National Technical Information Service
U.S. Department of Commerce
5285 Port Royal Road
Springfield, Va. 22151

U.S. SCIENTIFIC PROGRAM

Based upon reports requested by the U.S. IFYGL Project Office, the progress from January 1 through March 31, 1973, is presented for each of the U.S. IFYGL tasks. Some reports cover work done in April 1973.

Project area status reports follow the task reports.

Tasks

1. *Phosphorus Release and Uptake by Lake Ontario Sediments*

Principal Investigators: D.E. Armstrong and R.F. Harris - University of Wisconsin

No report.

2. *Net Radiation*

Principal Investigator: M.A. Atwater - CEM

A complete two-volume report on the work to date has been prepared by M.A. Atwater, J.T. Ball, and P.S. Brown, Jr. under the title "The Radiation Budget of Lake Ontario Including Cloud Cover: Preliminary Results". The second volume contains computer specifications. Abstract:

A horizontal array of 30 grid points is used to compute the radiation budget for Lake Ontario during IFYGL. A weighted-average analysis method computes meteorological variables, including cloud amount, at each grid point from surface observations. A stepwise linear regression technique determines the meteorological variables that statistically influence the low cloud amount over Lake Ontario. Linear regression equations for low cloud amounts over the lake in the absence of ship observations are developed. The mean error is reduced with only a small reduction in root-mean-square error.

A radiation model for use in a planetary boundary layer model or for computation of tropospheric radiative fluxes is used. It was designed for accuracy, economy, efficiency, and the inclusion of the major physical processes that alter the radiation fluxes. Empirical transmission functions for absorbers, scatterers, and clouds are used for the downward and upward solar and infrared fluxes. Computed solar fluxes are compared with observations at Brockport State University College, Brockport, N.Y., for a 6-month period.

Five versions of cloud analyses are used to compute spatially weighted, time-integrated radiative fluxes over Lake Ontario for daily and weekly time intervals from June through November.

3. *RFF/DC-6 Boundary Layer Fluxes*

Principal Investigator: B.R. Bean - ERL/NOAA

No report.

4. *Nitrogen Fixation*

Principal Investigator: R. Burris - University of Wisconsin

No report.

5. *Profile Mast and Tower Program*

Principal Investigator: J.A. Businger - University of Washington

We have developed programs for data reduction on our Raytheon minicomputer. Data analysis was delayed because of some computer hardware problems. These have now been rectified, and we are currently analyzing profiles of wind, temperature, and humidity taken from our tower near Rochester.

6. *Status of Lake Ontario Fish Populations*

Principal Investigator: J.F. Carr - Great Lakes Fisheries Laboratory

No report.

7. *Material Balance of Lake Ontario*

Principal Investigator: D.J. Casey - EPA

No report.

8. *Runoff*

Principal Investigator: L.T. Schutze - U.S. Army Corps of Engineers

First-cut estimates of monthly runoff from the U.S. basin were derived for December 1972 and January 1973. Corresponding estimates for the Canadian basin were not completed. No information has been

received regarding discharge measurements at the mouth of important tributaries to verify methods of extrapolating gaged runoff over ungaged areas. We plan to continue making first-cut estimates of monthly runoff from United States and Canadian land areas until agreement is reached on methods of extrapolating gaged data.

9. *Evaporation (Lake-Land)*

Principal Investigator: L.T. Schutze - U.S. Army Corps of Engineers

First-cut estimates of August-December 1972 monthly evaporation have been computed and are being coordinated.

10. *Simulation Studies and Analyses Associated With the Terrestrial Water Balance*

Principal Investigator: B.G. DeCooke - U.S. Army Corps of Engineers

Activity has not begun.

11. *Land Precipitation Data Analysis*

Principal Investigators: L.T. Schutze and R. Wilshaw - U.S. Army Corps of Engineers

Investigation of methods for estimating monthly precipitation from data obtained at key stations in the United States and Canada has begun.

12. *Transport Processes Within the Rochester Embayment of Lake Ontario*

Principal Investigator: W.H. Diment - University of Rochester

No report.

13. *Soil Moisture and Snow Hydrology*

Principal Investigator: W.N. Embree - U.S. Geological Survey

A procedure for obtaining monthly changes in soil moisture for each site as well as basinwide requires that data from two different areas of the basin be combined, as was done originally based on data from representative areas. It now appears that data on the extent and thickness of overburden will make it possible to more realistically determine the volume of materials likely to have an effect on soil-moisture changes.

Soil-moisture data were not collected in January and February because of equipment problems. Two runs were made in March. Snow cover was less this spring than during the past 2 years, and nearly zero after mid-March. Spring runoff was early and high, but not of record quantities. A final soil-moisture run is planned for early May. Work will be concentrated on analyzing data from existing sources for use in determining the role of soil moisture in the Black River and Lake Ontario basins.

14. *Boundary Layer Structure and Mesoscale Circulation*

Principal Investigator: M.A. Estoque - University of Miami

Preliminary analysis of data for 2 selected days, October 3 and 9, is complete. The first day was a lake-breeze day; the second day was characterized by a cold-air outbreak. The analysis consists of drawing vertical cross sections of the different meteorological variables along our surface station network.

15. *Mesoscale Simulation Studies*

Principal Investigator: M.A. Estoque - University of Miami

Work on theoretical modeling is progressing satisfactorily.

16. *Lake Level Transfer Across Large Lake*

Principal Investigator: C.B. Feldscher - LSC/NOAA

At a meeting of the Vertical Control-Water Levels Subcommittee of the Coordinating Committee on Great Lakes Basic Hydraulic and Hydrologic Data, the United States and Canadian principal investigators discussed and planned interim studies that could be carried out while awaiting data.

17. *Nearshore Ice Formation, Growth, and Decay*

Principal Investigator: A. Pavlak - General Electric Company

The field experiment continued as planned with the exception of some sensor damage noted in the October-December 1972 progress report. No additional problems have been encountered, and it is anticipated that the equipment will be shut down and retrieved during the first week in May.

Data reduction is proceeding as planned, and a preliminary data report covering the December-January period has been submitted to the IFYGL Project Office.

18. *Advection Term - Energy Balance*

Principal Investigator: J. Grumblatt - LSC/NOAA

No report.

19. *Occurrence and Transport of Nutrients and Hazardous Polluting Substances in the Genesee River Basin*

Principal Investigator: L.J. Hetling - New York State Department of Environmental Conservation

The biweekly stream-sampling program is continuing on schedule, and samples are being sent to G. Fred Lee. Computer programs for data storage and printout have been completed. Analytical and statistical computer programs have been started.

In January, a second set of samples was collected for analyses of pesticides, mercury, cadmium, zinc, lead, copper, nickel, manganese, chromium, and fluorides. A third set of samples will be collected in April for the same type of analyses. Two sets of sediment samples will be taken at each of the nine stations during the next quarter. These will be analyzed for phosphorus, iron, magnesium, aluminum, and calcium.

The following gives some background information for scientists interested in using information resulting from this task.

A great deal of work has been done studying the levels and the effects of nutrient enrichment in lake systems, while very little has been done to determine similar information with respect to streams. The object of this task is to determine the fate of nutrients, particularly phosphorus, that are impressed on a stream system through wastewater discharge.

Four streams in or adjacent to the Genesee River basin that receive significant wastewater discharges have been chosen for study (Fish Creek; Holcomb; Mud Creek, Victor; Spring Brook, Lima; and an unnamed tributary of Honeoye Creek, Avon). From each of these streams water and sediment samples will be taken every 2 weeks at 1/2-mi intervals for a distance of 3 to 4 mi downstream, and one sample will be taken of the discharge upstream. The stream and wastewater discharge samples will be subjected to the following 12 analyses:

1. Total organic carbon
2. Ammonia nitrogen
3. Organic nitrogen
4. Nitrite-nitrate nitrogen
5. Total phosphorus
6. Soluble phosphorus
7. Orthophosphate
8. Chlorides
9. Magnesium
10. Calcium
11. Iron
12. Aluminum

The sediment samples will be analyzed for:

1. Phosphorus
2. Magnesium
3. Calcium
4. Iron
5. Aluminum

A daily sampling program will be carried out for 1 week during the study period, which begins in April 1973 and ends in October 1973.

The results of this study will be used to develop a mathematical model as a tool for determining the assimilative capacity of streams and thus the levels of nutrient removal required from various wastewater discharges.

20. *Boundary Layer Flux Synthesis*

Principal Investigator: J.A. Almazan - CEDDA/NOAA

A preliminary analysis of surface meteorological data has been completed. The results were presented at the 16th Conference on Great Lakes Research in April 1973. In this analysis, covering the period July 7 to 21, 1972, the United States buoy and tower meteorological data were merged with the Canadian buoy meteorological data, which were received from CCIW in edited form. The results demonstrated that the air temperature, lake surface temperature, and wind speed data were, with some editing, of higher quality than the dew point data. The wind direction data need further analysis before editing procedures are established because of the lake-land effects. The pressure data were of rather poor quality. On the whole, however, the study, which included diurnal variations, daily averages, synoptic analysis, and estimates of momentum, heat, and moisture fluxes, showed that the data collected during the Field Year can be readily used in scientific analyses.

21. *Hazardous Material Flow*

Principal Investigator: T. Davies - EPA[1]

No report.

22. *Remote Measurement of Chlorophyll With Lidar Fluorescent System*

Principal Investigator: H.H. Kim - NASA

No report.

[1] T. Davies has replaced N.A. Jaworski as Principal Investigator on this task.

23. *Inflow/Outflow Term - Terrestrial Water Budget*

Principal Investigator: I.M. Korkigian - U.S. Army Corps of Engineers

The data resulting from the Lake Ontario outflow measurements have been submitted to the U.S. IFYGL Data Bank. It is anticipated that the final report on the measurements will be completed by the end of the next quarter.

24. *Use of an Unsteady-State Flow Model To Compute Continuous Flow*

Principal Investigator: I.M. Korkigian - U.S. Army Corps of Engineers

Work has not begun.

25. *Radiant Power, Temperature, and Water Vapor Profiles Over Lake Ontario*

Principal Investigator: P.M. Kuhn - ERL/NOAA

Work completed.

26. *Algal Nutrient Availability and Limitation in Lake Ontario*

Principal Investigators: G.F. Lee, N. Sridharan, and W. Cowen - University of Wisconsin

No report.

27. *Wave Studies*

Principal Investigator: P.C. Liu - LSC/NOAA

No report.

28. *Cloud Climatology*

Principal Investigator: W.A. Lyons - University of Wisconsin, Milwaukee

During the first week of March, two technicians, dispatched to overhaul all camera systems, found that the Hamilton 35-mm all-sky camera was damaged beyond repair in the field. It was returned to the University of Wisconsin, where it is now operational. All other cameras have come back on line and are working well, except for a brief shutdown of the 16-mm Bolex cameras in April. Pictures continue to be received and are of excellent quality. Solarimeter traces are coming in regularly and present no immediate problems. The panoramic pictures taken aboard

the ships also continue to be received and will prove very useful. The quality is excellent. The most exciting results to date have been the ERTS images over Lake Ontario, which have revealed a wide variety of lake-breeze effects and snow-squall patterns. These results have been summarized in a report.

Extension of our task until July 1973 will give us about one full year on which to base our solar radiation and climatological studies. The only problem, of course, is that it will be several months out of phase with the rest of the Field Year. The gaps in our photography that occurred during midyear mean that we will have less resolution in the climatological studies, perhaps, for example, a 25-km rather than a 10-km grid.

29. *Zooplankton Production in Lake Ontario as Influenced by Environmental Perturbations*

Principal Investigator: D.C. McNaught - State University of New York at Albany

No report.

30. *Change in Lake Storage Term - Terrestrial Water Budget*

Principal Investigator: R. Wilshaw - U.S. Army Corps of Engineers

Incoming data continue to be cataloged and stored. End-of-period levels have not been completely determined, and some gage data have not been received. A correlation program has been written to process data on a large computer in Chicago, but problems have developed that have prevented progress beyond testing of the program.

31. *Soil Moisture*

Principal Investigator: L.T. Schutze - U.S. Army Corps of Engineers

Investigation not begun.

32. *Testing of COE (Corps of Engineers) Lake Levels Model*

Principal Investigator: E. Megerian - U.S. Army Corps of Engineers

No report.

33. *Nearshore Study of Eastern Lake Ontario*

Principal Investigator: R.B. Moore - State University of New York at Oswego

No report.

34. *Internal Waves - Transects Program - Interpretation of Whole-Basin Oscillations*

Principal Investigator: C.H. Mortimer - University of Wisconsin, Milwaukee

We have continued the reduction and analysis of temperature vs. depth data collected during our three transect cruises aboard the *Researcher* and *Advance II*. The computer analysis is about 85 percent complete. We have converted, plotted, and scanned the following: four out of six field tapes from Cruise I, July 1972; six out of seven tapes from Cruise II, August 1972; and all tapes from Cruise III, October 1972.

Figures of most of the mechanical bathythermograph (MBT) and Center for Great Lakes Studies (CGLS) undulator data from Cruise II have been drafted, and drafting of the MBT data from Cruises I and III is in progress. A first look indicates that motions of the internal density structure are present on all time and space scales -- high frequency internal waves, whole-basin oscillations, and long-term changes. The time fluctuations in the temperature-density structure are anything but simple, and it will take considerable analysis before we can risk any written interpretations.

35. Pontoporeia affinis *and Other Benthos in Lake Ontario*

Principal Investigator: S.C. Mosley - University of Michigan

On a sampling cruise aboard the Canadian research ship *Limnos* from January 15 to 18, 1973, 13 sled tows were made at stations on four transects. These are the first winter samples of *Pontoporeia* in Lake Ontario. Three of the sled samples were fresh-frozen and sent to Clarence Haile, University of Wisconsin, for chemical analysis. Vertical zooplankton tows were made at five stations during the regular temperature survey on the *Limnos*.

Many additional samples have been converted to raw data.

36. *Pan Evaporation Project*

Principal Investigator: T.J. Nordenson - NWS/NOAA

The only observations made were with X-3 pans with heating elements.

Analysis of data from the U.S. stations is behind schedule because dew-point and radiation data are not available from collocated IFYGL land meteorological stations. Computation of shallow-lake evaporation for June through October 1972 was completed by three of the proposed methods for three Canadian stations.

At the request of J.A.W. McCulloch, the observation program will continue through June and possibly into July to provide a full year of reliable records at all stations. Latest information is that necessary dew-point and radiation data from the land meteorological stations will be available by late summer. Computations of shallow-lake evaporation will be made by four proposed methods. When data on change in energy storage and on advected energy are received, corrections will be made to obtain Lake Ontario evaporation estimates.

37. *Simulation Studies and Other Analyses Associated With U.S. Water Movements Projects*

Principal Investigator:: J.P. Pandolfo and C.A. Jacobs - CEM

Some minor modifications in the one-dimensional air/lake boundary layer model have allowed for specification (as opposed to prediction) of any or all of the atmospheric dependent variables, wind (u and v components), temperature (T), and humidity (q), as a function of height and time. This option was used to simulate the passage of a "typical" March cold front, with a gradual return to usual climatic conditions. Ten simulations with various combinations of specified atmospheric variables and horizontal gradients of u, v, T, and q made it possible to test the sensitivity of the model to combinations of input conditions not used before. Of the 10 simulations, 2 were judged to have best achieved the objectives of studying the response of Lake Ontario to the passage of a typical cold front.

Of primary concern in these simulation experiments was the detailed time and space (vertical) structure of currents, water temperature, sensible and latent heat fluxes, and stresses across the air water interface and within the water column. The results of these simulations will be compared with previous climatological simulations of the lake, as described in "Numerical Simulations of Lake Ontario With a One-Dimensional Air/Lake Model" by J.P. Pandolfo and C.A. Jacobs.

38. *Structure of Turbulence*

Principal Investigator: H.A. Panofsky - Pennsylvania State University

Two 1-hour runs have been analyzed, each in two sections, so that coherence and phase relationships are now available for four separate occasions. In all cases, the wind was nearly in line with the two towers, and the water was warmer than the air.

As predicted by H. Tennekes of Pennsylvania State University, the coherence between wind speeds on the towers was consistently better than for similar conditions over land. There were however, some significant differences, and there may not be enough supporting data, i.e., exact wind directions, to account for these differences.

In the case of the highest coherence value, there was an excellent linear relationship between phase delay and frequency at the two towers. The speed of the eddies was a few percent above the local wind speed, in agreement with results of wind tunnel tests. Vertical coherence was about the same as over land, as predicted, and the phase delay in the vertical was consistent.

Analysis of time series data from one buoy showed oscillations with periods of about 2 1/2 hours, with positive correlation between wind speed and direction. The data fell into two categories: "prefrontal" and "postfrontal." The latter showed an indication of additional fluctuations with periods of less than 1 hour.

Coherence and phase analyses will be made of additional runs, with emphasis on (1) winds at large angles to the towers, and (2) neutral and slightly stable conditions. Attempts will be made to infer the structure of fluctuations with periods of about 1 hour at the buoys by analyzing records from neighboring buoys, and, possibly, from aircraft.

39. *Airborne Snow Reconnaissance*

Principal Investigator: E.L. Peck - NWS/NOAA

Because of unseasonally warm weather, which removed the snow cover in the Lake Ontario basin, no surveys were flown during January. Snowstorms near the middle of February returned a snow cover, and by the end of the month the entire basin was covered. Aerial surveys were flown for the Syracuse Mission on February 28 and the Rochester Mission on March 1. The locations of all survey lines are shown in figure 2.

By early March the snow cover had vanished over much of the basin. Surveys were flown over the entire area on March 9 and 10. All lines were surveyed from March 28 to 30, when hope for additional snow cover had been abandoned. These final surveys will make better gamma radiation calibration possible.

The Office of Hydrology, National Weather Service, provided support in the installation of 12 special snowfall-measuring stations east of Oswego, N.Y. These were established to supplement the data on ground truth snow cover and snowfall that are being collected to evaluate the usefulness of the Oswego radar in measuring snowfall. Two new lines (S140 and S150 in fig. 2) were flown on all surveys in the area where ground truth snow data were being collected.

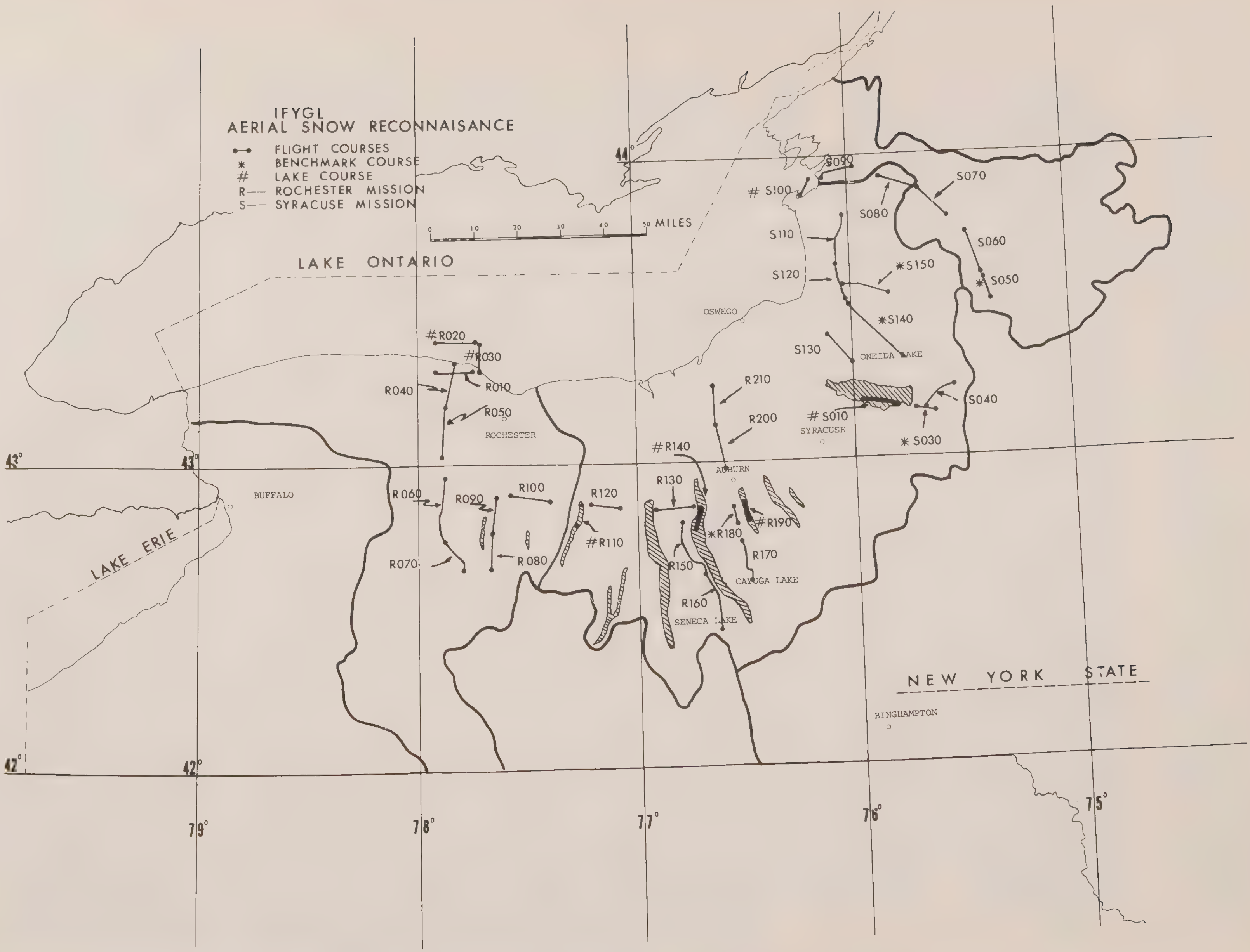

Figure 2. IFYGL aerial snow reconnaissance.

Ground observations of soil moisture and, when required, of snow cover were made over the calibration flight lines R180 and S030 (see fig. 2) on all days of gamma radiation surveys. Complete ground observations were made for the S050 calibration line on February 28, but not for the March flights because of swampy conditions.

A preliminary analysis, Interim Report #2 "Airborne Survey Water Equivalent" prepared by EG & G, Inc., for this task indicates the total apparent increase in water equivalent that would include the increase in the moisture in the upper layers of the soil. The latter was found to be substantial.

40. *Optical Properties of Lake Ontario*

Principal Investigator: K.R. Piech - Calspan Corporation

A first calendar-year progress report, considered a preliminary report on this task, has been submitted to the National Science Foundation and to the IFYGL Project Office.

41. *Storage Term - Energy Balance Program*

Principal Investigator: A.P. Pinsak - LSC/NOAA

No report.

42. *Sensible and Latent Heat Flux*

Principal Investigator: A.P. Pinsak - LSC/NOAA

No report.

43. *Thermal Characteristics of Lake Ontario and Advection Within the Lake*

Principal Investigator: A.P. Pinsak - LSC/NOAA

No report.

44. *Oswego Harbor Studies*

Principal Investigator: G.L. Bell - LSC/NOAA

No report.

45. *Mapping of Standing Water and Terrain Conditions With Remote Sensor Data*

Principal Investigator: F.C. Polcyn - University of Michigan

The objective of this task is to process ERTS data of the entire Lake Ontario drainage basin (in portions of eight frames) for discrimination of urban, agricultural, and other land uses, as well as total surface water. ERTS frames will also be analyzed for mapping lake water quality as indicated by spectral variations. The 3-day ERTS data set for August 1972 provides a synoptic look at almost the entire Lake Ontario basin and gives an adequate data base for meeting task objectives.

As reported in the paper given at the ERTS Symposium, March 5-9, 1973, preprocessing of ERTS data by taking ratios of channels yields correction for day-to-day changes in illumination.

Based on preliminary analysis of ERTS data for the Rochester, N.Y., and the Oakville, Ontario, areas, area analysis of eight ERTS frames to provide land use information for the hydrologic analysis of the basin is feasible. Results of water analysis in the New York Bight area and observations of suspended sediments from river discharge also show that task objectives can be met. Aircraft support data have been collected along the Lake Ontario shoreline.

Discussions with ground truth teams in Ontario have been held, and annotation of computer maps for the Oakville representative basin has begun. This annotation, coupled with stream runoff records will provide calibration between various land uses as measured by ERTS data and the water budget parameters needed for the hydrologic analysis of the Lake Ontario basin.

A program was written to improve conversion of ERTS digital data to the analog format needed for analysis with the Environmental Research Institute of Michigan-Spectral Analysis and Recognition Computer (ERIM-SPARC) system. This will provide a large-volume capability for taking ratio of channels and handling the eight ERTS frames being analyzed. Analog ratio maps have been generated that account for changes in illumination levels encountered in our study of data from 3 consecutive days.

Supporting aircraft coverage that will be correlated with the simultaneous passage of ERTS has been obtained for a time study of three major outfalls into Lake Ontario.

46. *Remote Sensing Program for the Determination of* Cladophora *Distribution*

Principal Investigators: F.C. Polcyn and C.T. Wezernak - University of Michigan

With the multispectral data and computer programs in hand, continued digitization of the shoreline data is planned to isolate total area of standing *Cladophora* beds within 1,000 ft of the shoreline. The near-infrared channel is used in the computer program to edit the data for changes in shoreline since a strong land-water boundary is present in that channel. Spectra of *Cladophora* beds at ground truth sites will be obtained and compared with measurements of biomass collected by divers. Studies will be made to ascertain whether or not the spectral data need to be corrected for water depth in order to obtain best correlations.

47. *Remote Sensing Study of Suspended Inputs Into Lake Ontario*

Principal Investigators: F.C. Polcyn and C.T. Wezernak - University of Michigan

No report.

48. *Island-Land Precipitation Data Analysis*

Principal Investigator: F.H. Quinn - LSC/NOAA

Precipitation data were collected continuously at the six Lake Ontario stations. Data tapes through February 1973 are being reduced. Tabulated precipitation data are available for 1971 and 1972. The data collection and reduction programs are on schedule.

49. *Lake Circulation, Including Internal Waves and Storm Surges*

Principal Investigator: D.B. Rao - University of Wisconsin, Milwaukee

No report.

50. *Atmospheric Water Balance*

Principal Investigator: E.M. Rasmusson - CEDDA/NOAA

Software development continues for a budget analysis that incorporates the orthogonal function analysis scheme devised by John B. Jalickee of CEDDA.

51. *Evaporation Synthesis*

Principal Investigator: E.M. Rasmusson - CEDDA/NOAA

Use of the Jalickee orthogonal function analysis scheme for obtaining low level humidity and wind fields, and lake surface temperature, has been examined. The scheme has been successfully tested on a sample of buoy data.

52. *Ground-Water Flux and Storage*

Principal Investigator: E.C. Rhodehamel - U.S. Geological Survey

Careful analysis of published and unpublished data on the consolidated and unconsolidated materials fronting on the lake indicates that 11 cfs is a reasonable value for the groundwater flux on the United States side. The shore is somewhat shorter and the materials less permeable than on the Canadian side, supporting a lower flux value.

Data have been collected and procedures established for computing monthly groundwater storage change. Specific-yield values were assembled from similar studies, from values reported in the literature, and from actual measurements. Water level changes resulting from the storm Agnes in June 1972 provided several opportunities for determining specific yield values. A procedure has been developed for computing an areally weighted change in groundwater storage for the entire basin.

53. *Spring Algal Blooms*

Principal Investigator: A. Robertson - IFYGL Project Office/NOAA

Analysis awaits the availability of data.

54. *Ice Studies for Storage Term - Energy Balance*

Principal Investigator: F.H. Quinn - LSC/NOAA

The Mexico Bay meteorological station was dismantled and returned to Detroit in late March. Data reduction is continuing. A field party collected data on ice thickness, water temperature, and solar radiation along the eastern shore of Lake Ontario between February 12 and 17. One aerial photographic ice survey was made in February.

55. *Lagrangian Current Observations*

Principal Investigator: J.H. Saylor - LSC/NOAA

No report.

56. *Circulation of Lake Ontario*

Principal Investigator: J.H. Saylor - LSC/NOAA

No report.

57. *Phytoplankton Nutrient Bioassays in the Great Lakes*

Principal Investigator: C. Schelske - University of Michigan

No report.

58. *Runoff Term of Terrestrial Water Budget*

Principal Investigator: C.K. Schultz - U.S. Geological Survey

The computation and tabulation of the mean weekly flows is about 85 percent completed. The various diversions from the Erie Barge Canal have been determined and included in the mean weekly flow of the Canal region. Field visits were made to most of the streamflow sites to obtain peak stages from the spring runoff.

The flow characteristics of Irondequoit Creek near Rochester are different from those of nearby streams. Direct correlation techniques have failed to produce satisfactory results. Other methods will be used to compute the mean weekly flow.

59. *Coastal Chain Program*

Principal Investigator: J.T. Scott - State University of New York at Albany

No report.

60. *Analysis of Phytoplankton Composition and Abundance*

Principal Investigator: E.F. Stoermer - University of Michigan

No report.

61. *Clouds, Ice, and Surface Temperature*

Principal Investigator: A.E. Strong - NESS/NOAA

NOAA-1 satellite visible and infrared imagery and ERTS-1 imagery were acquired throughout the reporting period in the formats specified in the last progress report. All pictures are available through Documentation Service, National Environmental Satellite Service (NESS), NOAA, FOB 4, Room 1167, Suitland, Md. 20233.

Several infrared images have been retained at NESS for surface temperature analyses of the Great Lakes, including Lake Ontario. As soon as these analyses have been completed, preparation of the final data report will begin.

62. *Analysis and Model of the Impact of Discharges From the Niagara and Genesee Rivers on Nearshore Biology and Chemistry*

Principal Investigator: R.A. Sweeney - State University of New York at Buffalo

No report.

63. *NCAR/DRI - Buffalo Program*

Principal Investigator: J.W. Telford - Desert Research Institute, University of Nevada

No report.

64. *Mathematical Modeling of Eutrophication of Large Lakes*

Principal Investigator: R.V. Thomann - Manhattan College

The primary effort has been final debugging of a vertically layered phytoplankton model. Preliminary runs have been made, and a sample result is given in figure 3, which shows the simulated phytoplankton chlorophyll *a*, ammonia, nitrate, and phosphate concentrations in the epilimnion.

The vertical layers of the model represent an epilimnion, hypolimnion, and benthos, with stratification accomplished by temporally varying the vertical dispersion between the epilimnion and hypolimnion. Nine interactive systems are simulated for a 1-year period for each of the three layers; therefore, 27 simultaneous nonlinear equations must be solved for the 1-year period, with a required integration step of about 1/2 day. A more complete nutrient data set has been gathered for the base year chosen. The data have been grouped according to depth intervals and displayed temporally, and means and standard deviations have been computed.

Plans call for continual sensitivity analysis and preliminary verification of the three-layered vertical model.

65. Cladophora *Nutrient Bioassay*

Principal Investigators: G.F. Lee and W. Cowen - University of Wisconsin

No report.

66. *Sediment Oxygen Demand*

Principal Investigator: N.A. Thomas - EPA

Chemical analysis of sediment samples is progressing. Sediment oxygen demand rates have been calculated, and a final report will be prepared when the chemical analysis has been completed. The highest rates were observed at station 98 in the eastern part of the basin, and at station 12 in the western part.

67. *Main Lake Macrobenthos*

Principal Investigator: N.A. Thomas - EPA

Identification of benthic organisms continues. A toxonomic workshop was held in Ann Arbor, Mich., for the benefit of IFYGL investigators working on Lake Ontario benthos. Sediment samples collected at the macrobenthos stations are being analyzed.

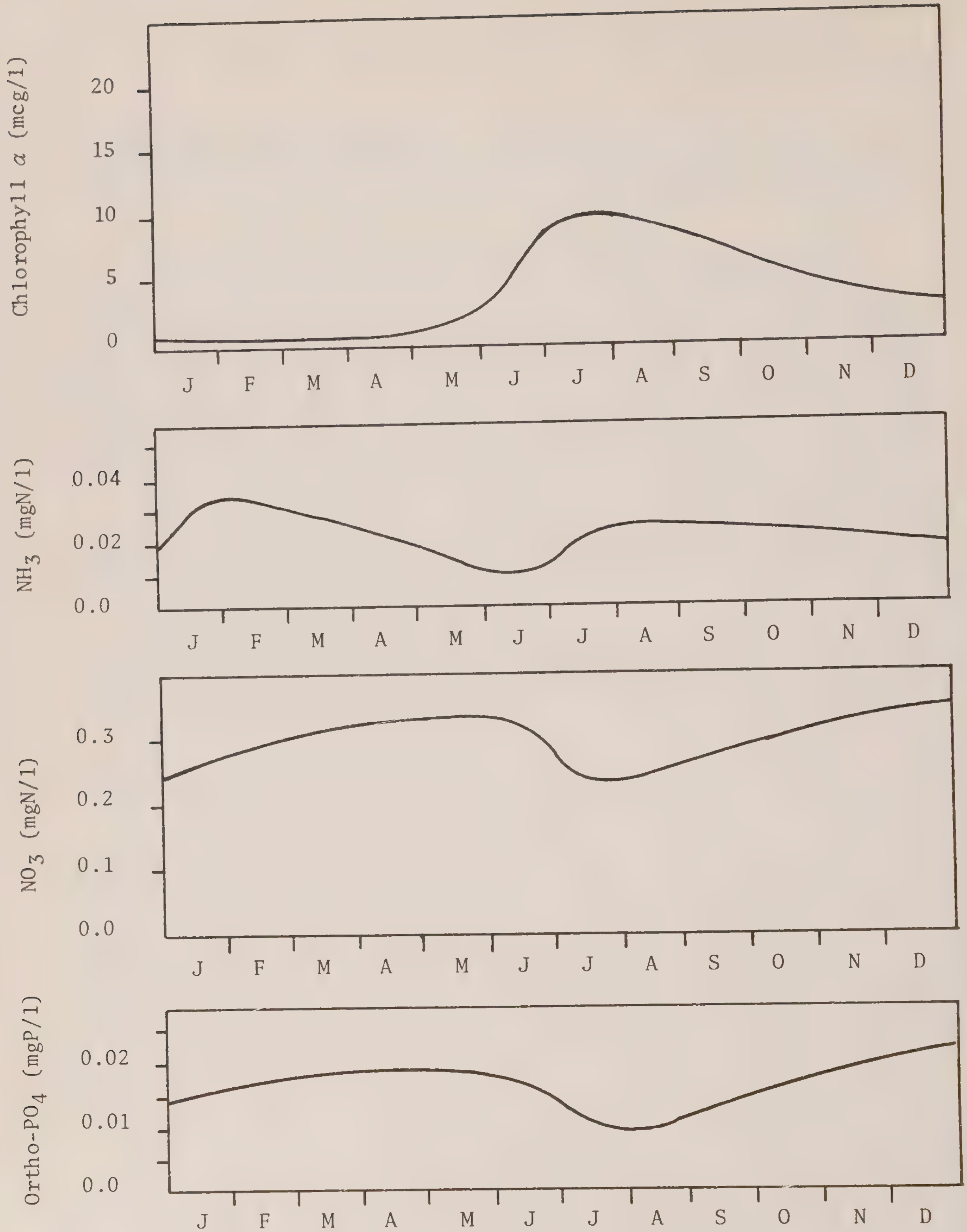

Figure 3. Sample result of phytoplankton model preliminary run.

68. *Exploration of Halogenated Hazardous Chemicals in Lake Ontario* [2]

Principal Investigator: G.F. Lee - University of Wisconsin

No report.

69. *Basin Precipitation - Land and Lake*

Principal Investigator: J.W. Wilson - CEM

Operation of the Oswego radar was terminated on March 19, 1973, and of the Buffalo radar on April 1, 1973. The success of the data collection was evaluated by examining 16-mm photographs of the PPI scope, the radar operators' written comments, and data collected on magnetic tape. The results of this analysis have been prepared for the report on the "U.S. Precipitation Data Acquisition System" to be issued by the IFYGL Project Office. The Oswego magnetic tape data for periods when precipitation was occurring over the lake or watershed are essentially complete, except for 303 hours of precipitation, which are missing because of malfunctions in the tape recorder. The data for these hours, were, however, successfully collected on film. At Buffalo, data were not successfully recorded on tape during several periods. Including both radars, approximately 750 hours of missing tape data can be recovered from data collected on 16-mm film.

The Oswego raw radar data have been edited, checked for errors, and compacted (Data Set 1), and the Buffalo data will be within 2 weeks.

Significant progress has been made in deriving hourly precipitation totals from both the Oswego and Buffalo data (Data Set 2). Except for 10 days in June, hourly totals have been derived through January 1973 for all periods for which data are available on magnetic tape. Considerable progress has also been made in deriving daily precipitation totals for the eastern half of Lake Ontario. These are preliminary estimates, based only on the Oswego radar data, no rain-gage data. Similar totals for the western half of the lake cannot be made until the missing Oswego magnetic tape data have been extracted from film.

A computer program has been completed for extracting from magnetic tape, supplied by the National Climatic Center, rainfall totals from recording gages within 120 mi of the Buffalo and Oswego radars.

During the quarter, precipitation was successfully measured by the 13 gages in the Oswego snow network. In addition, 80 high school students made observations of snow depth, water content, and snow crystal types within the network area. A spot check indicates that these observations will be very useful. In view of the unique opportunity that existed to obtain detailed measurements from various observation systems, the few significant snow events were a major disappointment.

---

[2] Title of this task as given in Bulletin No. 6 was incorrect.

Initial results of converting echo intensity to snowfall rate by means of equations quoted in the literature show large underestimates in water content compared with that measured over the snow network. Before reliable estimates can be made, studies of the Oswego snow network and radar data are required to derive equations and procedures for converting echo intensity data to precipitation estimates.

Data were recently received from the raindrop distrometer operated by the Canadians in the Bowmanville rain-gage network. Comparison of these data with the Buffalo radar data and rain-gage data during storm Agnes has begun. The first estimates of rainfall from the Woodbridge radar are available. It is expected that the much delayed report on rainfall measurements during Agnes will be prepared during the next quarter.

70. *Evaluation of ERTS Data for Certain Hydrological Uses*

Principal Investigators: D.R. Wiesnet and D.F. McGinnis - NESS/NOAA

On October 11 and 13, 1972, low-level multispectral photography was obtained of the Scipio and Verona, N.Y., test sites by the NCAR Buffalo aircraft, which also carried a thermal infrared scanner to secure thermal (8 to 14 μm) data over the sites. On the same dates, soil moisture samples were collected at these sites, and gamma-ray ground truth data were obtained in conjunction with snow studies conducted by E.L. Peck. ERTS-1 data have been received in the form of multispectral scanner images for the same areas. The ERTS-1 printout in all four bands has been obtained from the ERTS digital tapes, but a significant number of parity errors may make it necessary to reorder tape from NASA. Out of four attempts to fly the correct flight line for thermal imagery only one was completely successful. After preliminary inspection, the multispectral aerial photography seems satisfactory although the image motion compensation in the four-band camera that had been requested was inadvertently lacking.

Excellent imagery of the ice in Lake Ontario was received in late March and will be useful for comparison with aircraft data and shore observations. NOAA-2 digital printouts reveal a significant difference in the relative reflectivity of the Tug Hill Plateau and Adirondack forests during time of snow cover. These data will be checked against ERTS-1 digital data for corroboration.

Percent snow cover in the Genesee River basin was measured by NOAA-2's very high resolution radiometer (VHRR) during February and March. Several excellent images of VHRR thermal and visible-band imagery of Lake Ontario have also been obtained. Digital tapes have been ordered.

71. *Distribution, Abundance, and Composition of Invertebrate Fish-Forage Mechanisms in Lake Ontario*

Principal Investigator: J.F. Carr - Great Lakes Fisheries Laboratory

No report.

72. *Coastal Circulation in the Great Lakes*

Principal Investigator: G.T. Csanady - Woods Hole Oceanographic Institution

Work has continued on the 1972 spring alert data on the development of the theoretical framework for the understanding of lake circulation, and has extended also to the summer alert data covering the period July 15 to August 15. The following reports had been prepared by the end of February:

"Equilibrium Theory of the Planetary Boundary Layer With an Inversion Lid," transmitted to the IFYGL Project Office, submitted to Boundary Layer Meteorology, and now under revision after journal review. (W.H.O.I. Contribution No. 3011)

"Transverse Internal Seiches in Large, Oblong Lakes and Marginal Seas," transmitted to IFYGL Project Office, submitted to Journal of Physical Oceanography, and now under revision after journal review. (W.H.O.I. Contribution No. 3043.)

"Spring Thermocline Behavior in Lake Ontario During IFYGL," transmitted to the IFYGL Project Office, and submitted to Journal of Physical Oceanography. (W.H.O.I. Contribution No. 3053.)

"Wind Induced Barotropic Motions in Long Lakes," submitted for publication to Journal of Physical Oceanography, being revised after journal review; will be submitted to IFYGL Project Office after revision. (W.H.O.I. Contribution No. 3082.)

73. *Lake Water Characteristics*

Principal Investigator: A.P. Pinsak - LSC/NOAA

No report.

74. *Snow Observation Network*

Principal Investigator: R.B. Sykes - State University of New York at Oswego

No report.

75. *Lake Circulation Model* [3]

Principal Investigator: J.R. Bennett - IFYGL Project Office/NOAA

The objective of this task is to develop a numerical model for prediction of lake currents and temperatures on time scales ranging from 1 day to 1 year. The model will be used to simulate the effect of wind and heat flux on the circulation of the lake and the diffusion of dynamically passive substances. It will also be used to test the consistency of the lake measurements with the estimated surface fluxes of heat and momentum. The model has been formulated, programmed, and is being checked out.

76. *Lake Ontario Invertebrate Fauna List* [4]

Principal Investigator: A. Robertson - IFYGL Project Office/NOAA

The objectives of this task are to determine what invertebrate species have been reported from Lake Ontario, and which of these species are of sufficient importance to the lake ecosystem to be considered in modeling of biological processes within the lake. Work is underway; a provisional benthic list has been developed and is being corrected.

[3] This is a new task initiated in January 1973.

[4] This is a new task initiated in April 1973.

Project Areas

Boundary Layer - J.Z. Holland, U.S. Panel Cochairman

A limited amount of data has been exchanged within the panel. A meeting is scheduled for June 1973 to discuss preliminary results and further exchanges of data.

Several papers based on preliminary results of boundary layer studies were presented at the 16th Conference for Great Lakes Research in April.

U.S. Field Headquarters

Activities at the U.S. Field Headquarters in Rochester since December 1972 have been limited to postlogistic and administrative functions connected with the final cleanup of the ship and rawinsonde programs. Postcalibration check of the ship radiometers and dew-point sensors has been completed at AES, Downsview, Ontario.

The Physical Data Collection System (PDCS) -- previously referred to as the Texas Instruments System -- was the only operational network under the responsibility of the Rochester Office from January to April 1973. The data collection is discussed below under "Buoys, Towers, and Land Stations."

Note: Those having mail sent to the IFYGL, P.O. Box 4727, Rochester, N.Y., address should notify the Charlotte Station, Rochester, N.Y. 14612 of change of address. Only first class mail will be forwarded to the IFYGL Project Office in Rockville, Md. All other mail will be disposed of according to Post Office regulations.

Buoys, Towers, and Land Stations

The Physical Data Collection System (PDCS) was operational through March 31, 1972. Six stations collected data: The Fort Niagara, Golden Hill, Rochester, Oswego, and Stony Point land stations and the Galloo Island station. Spare sensors, taken from the lake platforms, made it possible to schedule rotation of sensors through the Rochester laboratory for calibration checks. Observers were hired under contract to clean radiometer hemispheres daily and prepare visual observation reports on the other sensors. This was done routinely at the Golden Hill, Rochester, Oswego, and Stony Point stations. The Galloo Island station was operated and maintained by engineers transported from and to Rochester by a U.S. Coast Guard helicopter. The local island resident, under contract, changed the propane gas bottles and made visual observations of the equipment every couple of weeks.

During April the remaining six stations were dismantled. The pressure and wind direction sensors were postcalibrated in Rochester, where post-calibration checks were also performed on the wind speed and dew-cell sensors and the electronic measurement units. The air temperature sensors were sent to the National Oceanographic Instrumentation Center (NOIC) for postcalibration, and a few radiometers were checked at AES, Downsview, Ontario.

Some of the equipment from the 20 stations was sent to the Lake Survey Center in Detroit, some to the National Data Buoy Center in Bay St. Louis, Miss. Premises in Rochester were vacated by May 1, 1973, closing the IFYGL Field Headquarters operations.

Positions of U.S. IFYGL Ships

The officially designated stations occupied by the *Researcher* and the *Advance II* during IFYGL were specified in Table 2.2.3.2(B) in Volume 3 of the IFYGL Technical Plan. A slightly modified version is included here (see table 2) for the convenience of the reader.

The numbers in the first column, under "IFYGL Station Identifiers," were used aboard the vessels and all data originating from the U.S. ship stations are identified by these numbers. The numbers in the second column, under "IFYGL Station No.," were used to designate positions during the planning phases of IFYGL, and the Canadian vessels used these numbers throughout IFYGL as station identifiers. A single "x" in the last column indicates 1 of 60 water quality stations; a double "x" indicates 1 of 5 master water quality stations.

For the most part, the U.S. ships occupied actual positions close to the officially designated ones. In a few instances, positions were altered slightly. The stations off the Welland Canal (No. 12) and off the entrance to the St. Lawrence River (No. 99) were particularly liable to alteration because of heavy traffic. The ships' logs provide the only completely reliable record of exact positions.

Aircraft Operations

A NASA U-2 remote sensing flight was made over Lakes Ontario and Erie on March 23, 1973. The area covered is a rectangle bounded by 78°W and 81°N north of Toronto and south of Lake Erie. Clear sky conditions prevailed. This is the NASA flight originally planned with an RB-57 and suggested by the IFYGL Remote Sensing Committee.

Table 2. Station locations for the NOAA ship Researcher and the Cape Fear Technical Institute ship Advance II during IFYGL.

IFYGL station identifier	IFYGL station No.	Geographic position		Approx. depth (m)	Approx. depth (ft)	Water quality station
		Latitude N (deg min sec)	Longitude W (deg min sec)			
1	1	43 22 48	79 40 48	33	108	x
2	2	43 15 36	79 38 24	16	55	x
3	3	43 13 12	79 25 12	15	50	x
4	4	43 16 48	79 26 24	66	215	
5	5	43 21 36	79 28 48	95	310	x
6	6	43 26 24	79 30 00	82	270	
7	7	43 32 24	79 33 00	16	50	x
8	8	43 36 00	79 21 00	15	50	x
9	9	43 31 12	79 19 12	104	340	
10	10	43 25 12	79 16 48	119	390	xx
11	11	43 19 12	79 14 24	90	295	
12	12	43 15 36	79 13 12	55	180	x
13	13	43 19 12	79 04 12	10	35	
14	14	43 17 24	79 00 00	10	32	x
15	15	43 24 00	79 00 36	102	335	x
16	16	43 27 36	79 01 12	127	415	
17	17	43 33 00	79 03 36	130	425	x
18	18	43 39 36	79 04 48	106	345	
19	19	43 45 36	79 07 12	14	45	x
20	20	43 49 48	78 51 00	18	60	x
21	20A	43 47 24	78 50 24	38	125	
22	20B	43 45 36	78 49 48	60	195	
23	21	43 43 48	78 49 12	82	270	
24	22	43 39 00	78 48 00	114	375	xx
25	23	43 34 48	78 46 48	146	480	
26	24	43 30 36	78 46 12	146	480	x
27	25	43 26 24	78 44 24	128	420	
28	25A	43 25 12	78 45 00	104	340	
29	25B	43 22 48	78 44 24	64	210	
30	26	43 21 36	78 43 48	20	65	x
31	27	43 23 24	78 30 00	28	90	x
32	28	43 32 24	78 30 00	171	560	x
33	29	43 38 24	78 30 00	145	475	
34	30	43 45 00	78 30 00	85	280	x
35	31	43 52 48	78 30 00	18	60	x

Table 2. Station locations for the NOAA ship Researcher *and the Cape Fear Technical Institute ship* Advance II *during IFYGL (continued)*

IFYGL station identifier	IFYGL station No.	Geographic position Latitude N (deg min sec)			Geographic position Longitude W (deg min sec)			Approx. depth (m)	Approx. depth (ft)	Water quality station
36	32	43	55	12	78	14	24	14	45	x
37	33	43	51	36	78	14	24	52	170	
38	34	43	45	36	78	13	48	99	325	x
39	35	43	39	00	78	13	12	151	495	
40	36	43	31	48	78	12	36	175	575	x
41	37	43	23	24	78	12	00	9	30	x
42	38	43	23	24	77	59	24	15	50	x
43	39	43	27	00	78	00	00	120	395	
44	40	43	31	12	78	00	00	174	570	x
45	41	43	35	24	78	00	36	183	600	xx
46	42	43	43	48	78	01	12	120	395	x
47	43	43	49	12	78	02	24	72	235	
48	44	43	55	48	78	03	00	26	85	x
49	45	43	56	24	77	40	48	20	65	x
50	45A	43	54	36	77	40	48	38	125	
51	45B	43	52	12	77	41	24	55	180	
52	46	43	49	48	77	41	24	65	215	x
53	47	43	45	00	77	42	00	96	315	
54	48	43	39	36	77	43	12	139	455	x
55	49	43	33	00	77	43	12	165	540	
56	50	43	27	00	77	44	24	134	440	x
57	50A	43	25	12	77	44	24	110	360	
58	50B	43	22	48	77	45	00	71	235	
59	51	43	21	36	77	45	00	26	85	x
60	52	43	15	36	77	30	00	12	40	x
61	53	43	22	12	77	30	00	131	430	
62	54	43	28	48	77	30	00	169	555	x
63	55	43	35	24	77	30	00	151	495	
64	56	43	41	24	77	30	00	85	280	x
65	57	43	48	00	77	30	00	52	170	
66	58	43	54	90	77	26	00	12	40	x
67	59	43	49	12	77	15	00	20	65	x
68	60	43	43	12	77	15	00	82	270	
69	61	43	35	24	77	15	00	152	500	x
70	62	43	20	24	77	15	00	194	635	

Table 2. Station locations for the NOAA ship Researcher *and the Cape Fear Technical Institute ship* Advance II *during IFYGL (continued)*

IFYGL station identifier	IFYGL station No.	Geographic position						Approx. depth (m)	Approx. depth (ft)	Water quality station
		Latitude N (deg min sec)			Longitude W (deg min sec)					
71	63	43	23	24	77	15	00	186	610	x
72	64	43	18	00	77	15	00	24	78	x
73	65	43	18	00	76	56	24	17	55	x
74	66	43	25	12	76	57	36	157	515	
75	67	43	29	24	76	58	48	233	765	xx
76	68	43	34	12	76	59	24	181	595	
77	69	43	40	12	77	00	36	114	375	x
78	70	43	48	00	77	02	24	53	175	x
79	71	43	53	24	76	54	00	20	65	x
80	71A	43	51	36	76	53	24	37	120	
81	71B	43	49	48	76	52	12	55	180	
82	72	43	48	00	76	49	48	66	215	
83	73	43	44	24	76	47	24	99	325	x
84	74	43	40	12	76	43	48	136	445	
85	75	43	36	00	76	40	48	188	615	x
86	76	43	32	24	76	37	12	151	495	
87	76A	43	30	36	76	36	36	110	360	
88	76B	43	28	48	76	35	24	62	205	
89	77	43	25	12	76	45	00	76	250	x
90	78	43	28	12	76	34	12	13	42	x
91	79	43	31	48	76	27	00	21	70	
92	80	43	40	12	76	22	48	67	220	x
93	81	43	43	12	76	30	00	84	275	
94	82	43	50	24	76	30	36	35	115	x
95	83	43	54	00	76	42	36	18	60	x
96	84	43	58	48	76	40	48	35	115	xx
97	85	44	00	36	76	48	00	29	96	x
98	86	44	04	48	76	36	00	22	72	x
99	87	44	00	00	76	28	48	40	130	x
100	88	43	56	24	76	20	24	23	75	
101	89	43	54	00	76	16	48	31	100	
102	90	43	48	00	76	19	48	24	80	
103	91	43	45	00	76	15	00	27	90	x
104	92	43	39	36	76	14	24	20	66	
105	93	43	33	00	76	18	00	26	85	x

Physical Data Collection System (PDCS) Data

Efforts have primarily consisted of developing detailed plans for personnel and work requirements for manual and computer processing of the limnological and meteorological data obtained from the Physical Data Collection System (PDCS). A working team has been established at the Center for Experiment Design and Data Analysis (CEDDA) representing the IFYGL Project Office, CEDDA, and the Lake Survey Center (LSC). Work has begun at CEDDA toward verifying and determining procedures for treating data from the 15 sensor types of the PDCS (see table 3), and interpreting and applying electronics and sensor calibration information. In cooperation with the working team, computer facility personnel at LSC are doing the design and programming necessary for merging of real-time, cassette, and RCC weekly tape data (the three basic PDCS data sets), for appropriate conversion to scientific units, and for storage into a random access disk-pack data base.

Table 3. Physical data collection system

Sensor	Parameter measured
1	Air temperature
2	Atmospheric pressure
3	Pan evaporation
4	Precipitation
5	Longwave radiation
6	Shortwave radiation
7	Dew point
8	Wind direction (buoys)
9	Wind direction (except buoys)
10	Wind speed
11	Water temperature (except evaporation pans)
12	Water temperature (evaporation pans)
13	Current direction (buoys)
14	Current speed (buoys)
15	Current direction and speed (towers)

Figure 4 shows the availability of real-time and cassette PDCS data. The cassettes were used in two modes. If a radio was not available at a PDCS station, an 11-day cassette was used on site as the primary storage unit; if a radio was available at the station, a 3-day cassette was on site as backup in case of radio failure.

PLATFORM	LOCATION	IFYGL STATION ID	MAY 1972 / JUNE 1972 / JULY 1972 (1...5....0....5....0....5.....11...5....0....5....0....5....01...5....0....5....0....5.....1)
BUOY	OLCOTT	12	XXX**** 0000X
BUOY	OLCOTT	13	0000XXXXX XXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXXX
BUOY	OSWEGO	18	00000000000
BUOY	OSWEGO	19	XXXXXXXX XXXXXXXXXXXXXXXXXXXXX XXXXXXX
BUOY	OSWEGO	20	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX****XXXXXXXXXXXXXXXXXXXX 0000
BUOY	OSWEGO	21	XXXXXXXXXXXXXXXXXXXXXX/XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
BUOY	ROCHESTER	14	XXXXXXXXXXXXXX*****0000*XXXXXXX**0*XXXXXXXXXXXXX
BUOY	ROCHESTER	15	000000000000
BUOY	ROCHESTER	16	XX XXXX**0**XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX****XXXXXXXXXXXXXX
BUOY	ROCHESTER	17	X0000*XXXXXXXXXXXXXXXXXXXXXX****X
TOWER DEEP	OLCOTT	23	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
TOWER SHALLOW	OLCOTT	24	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
TOWER DEEP	ROCHESTER	26	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXX****XXXXXXXXXXXXXXXXXXXXX 00
TOWER SHALLOW	ROCHESTER	27	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
LAND	FORT NIAGARA	22	XXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
LAND	GOLDEN HILL	25	XXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
LAND	ROCHESTER	28	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
LAND	OSWEGO	29	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
LAND	STONY POINT	31	XXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXX
ISLAND	GALLOO ISLAND	30	

PLATFORM	LOCATION	IFYGL STATION ID	AUGUST 1972 / SEPTEMBER 1972 / OCTOBER 1972 (1...5....0....5....0....5.....11...5....0....5....0....5....01...5....0....5....0....5.....1)
BUOY	OLCOTT	12	XXXXXXX****XXXXXXXXXXXXXXXXXXXXXX****0***0000**
BUOY	OLCOTT	13	XXXXXXXX****XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXX XXXX XXXXX
BUOY	OSWEGO	18	
BUOY	OSWEGO	19	XXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXX
BUOY	OSWEGO	20	00***0000000000 00000XXXXXXX 0000 000***XX******* *** 0000
BUOY	OSWEGO	21	XXXXXXX XXXXXXXXXXX 000*XXXXXXXXXX XXXXXXXXXXXXXX*000000000
BUOY	ROCHESTER	14	XXXXXXX X XXXXX 000******XXXXXXXXXX 000000000000000000000000
BUOY	ROCHESTER	15	XXXXXXXXXXXXXXX
BUOY	ROCHESTER	16	XXXXXXX*000 XXXXXXXXXXXXXXXXXX****X**0*XXXXXXXXXX0000000000*00***0****00000 ***00
BUOY	ROCHESTER	17	XXXX**00**XXXX XXXXXXXXXXXXXXX XX 000000000000 00
TOWER DEEP	OLCOTT	23	XXXXXXX XXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXX ******************X
TOWER SHALLOW	OLCOTT	24	XXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXX XXXXXX****XXXXXXXXX
TOWER DEEP	ROCHESTER	26	00 XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXX X***0 000000000000000000
TOWER SHALLOW	ROCHESTER	27	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX/XXXXXXXXXX XXXXXX*****0000***00*****
LAND	FORT NIAGARA	22	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX X***0 XXXXXXX*****XXX
LAND	GOLDEN HILL	25	XX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXX XXXXXXXXXXXXXXXXXXXXXXXXX
LAND	ROCHESTER	28	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXX
LAND	OSWEGO	29	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXX
LAND	STONY POINT	31	XXXXXXX XXXXXXXXXXXXXXXX XXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXX
ISLAND	GALLOO ISLAND	30	XXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXX

X = DATA COLLECTED BY THE REAL TIME SYSTEM
0 = DATA COLLECTED ON CASSETTE TAPE
* = DATA COLLECTED BY BOTH

Figure 4. PDCS data collected.

```
                                               NOVEMBER 1972                 DECEMBER 1972                JANUARY 1973
                                  IFYGL           1    1    2    2    3          1    1    2    2    3          1    1    2    2    3
PLATFORM        LOCATION        STATION ID   1...5....0....5....0....5....01...5....0....5....0....5....01...5....0....5....0....5.....1

BUOY            OLCOTT              12
BUOY            OLCOTT              13
BUOY            OSWEGO              18
BUOY            OSWEGO              19
BUOY            OSWEGO              20       0
BUOY            OSWEGO              21
BUOY            ROCHESTER           14                      0
BUOY            ROCHESTER           15
BUOY            ROCHESTER           16       *0*0000   00000000
BUOY            ROCHESTER           17       0
TOWER DEEP      OLCOTT              23       XX
TOWER SHALLOW   OLCOTT              24
TOWER DEEP      ROCHESTER           26       0000 00000     00000000000
TOWER SHALLOW   ROCHESTER           27       ***0000000000000
LAND            FORT NIAGARA        22         XXXXXXXXXXXXXX  XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
LAND            GOLDEN HILL         25       XXXXXXXXXXXXXXXX  XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
LAND            ROCHESTER           28       XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
LAND            OSWEGO              29       XXXXXXXXXXXXXXXXX  XXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
LAND            STONY POINT         31       XXXXXXXXXXXXXXXXX  XXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
ISLAND          GALLOO ISLAND       30       XXXXXXXXXXXXXXXXX  XXXXXXX   XXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX


                                              FEBRUARY 1973            MARCH 1973
                                  IFYGL           1    1    2    2 2         1    1    2    2     3
PLATFORM        LOCATION        STATION ID   1...5....0....5....0....5..81...5....0....5....0....5.....1

BUOY            OLCOTT              12
BUOY            OLCOTT              13
BUOY            OSWEGO              18
BUOY            OSWEGO              19
BUOY            OSWEGO              20
BUOY            OSWEGO              21
BUOY            ROCHESTER           14
BUOY            ROCHESTER           15
BUOY            ROCHESTER           16
BUOY            ROCHESTER           17
TOWER DEEP      OLCOTT              23
TOWER SHALLOW   OLCOTT              24
TOWER DEEP      ROCHESTER           26
TOWER SHALLOW   ROCHESTER           27       XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
LAND            FORT NIAGARA        22       XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
LAND            GOLDEN HILL         25       XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
LAND            ROCHESTER           28       XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
LAND            OSWEGO              29       XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
LAND            STONY POINT         31       XXXXXXXXXXXXXXXXXXXXX0000  XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
ISLAND          GALLOO ISLAND       30       XXXXXXXXXXXXXXXXXXXXX  0000XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX

                X = DATA COLLECTED BY THE REAL TIME SYSTEM
                0 = DATA COLLECTED ON CASSETTE TAPE
                * = DATA COLLECTED BY BOTH
```

Figure 4. PDCS data collected (continued).

It may be possible in many cases to partly or completely fill gaps in the real-time data with the data stored on the cassettes. Another possibility, now being studied, is filling gaps by merging the data on the RCC weekly tapes.

Rawinsonde Data

Table 4 shows the length in minutes of every scheduled rawinsonde flight from all six stations (three United States and three Canadian). Downtrack as well as uptrack data were recorded when possible for releases at 0300, 0900, 1500, and 2100 GMT. The average rate of rise was 300 m/min. From September 21 to December 11, 2,958 soundings were recorded. Because of parity problems in reading the field tapes and because of software problems encountered in the field, 132 of these soundings had to be worked up manually from the strip charts. This was done by the 6th Weather Squadron at Tinker AFB.

Since temperature, humidity, and pressure were recorded every 0.8 sec, a very fine structure of the atmosphere can be identified. Time-series plots will be made on microfilm of all original, unedited, meteorological data in frequency and Loran-C data in time difference. A sample plot is shown in figure 5. The basic archive products from these data will be 5-sec averages, values for every 10- and 50-mb level in scientific units on magnetic tape, and adiabatic plots on microfilm.

Table 4. Rawinsonde data in minutes

Rawinsonde station	Sept. 21	Sept. 22								Sept. 23							
	12	00	03	06	09	12	15	18	21	00	03	06	09	12	15	18	21
Stony Point	0	74	28	40	52			24	75	55	43		79	67	23	87	42
Sodus Point	15	13	81	43	58	61	74	52	62	52	39	101	42	77	89	72	49
Lakeside		71	64	54		72	41	76	65	70	78	65	53	74	93	28	73
Confederat. Pk.	0	62	103	51	81	61	65	98	82	64	94	81	74	73	69	86	71
Scarborough	56	99	65	67	66	24	60	32	22	52	61	45	76	52	88	51	54
Presqu'ile	65	70	86	70	49	66	65	58	61	60	63	72	83	72	78	64	81

Rawinsonde station	Sept. 24								Sept. 25							
	00	03	06	09	12	15	18	21	00	03	06	09	12	15	18	21
Stony Point	51	55	49	32	64	62	50	70	57	49	80	39	64	25	68	34
Sodus Point	44	46	47	80	85	58	83	40	62	55	50	101	97	92	82	114
Lakeside	55	65	54	46	85	28	74	89	69		57	94	77	87	69	70
Confederat. Pk.	74	142	46	84	88	58	54	60	67	87	91	88	82	81	61	91
Scarborough	71	57	63	67	49	65	64	47	10	73	55	85	59	74	47	82
Presqu'ile	63	63	84	64	57	66	64	56	63	71	74	70	82	55	73	71

Rawinsonde station	Sept. 26								Sept. 27		Sept. 28		Sept. 29		Sept. 30	
	00	03	06	09	12	15	18	21	00	12	00	12	00	12	00	12
Stony Point	54	45	49	35	6	24	29	56	66	15	52	69	63	36	21	
Sodus Point	51	50	55	63	89	74	19	48	56	48	52	57	44	77	62	98
Lakeside	75	82	44	3	50	20	85	70	26	73	31	83	72	66	60	2
Confederat. Pk.	49	94	56	72	66	71	48	94	49	70	75	34	81	53	62	27
Scarborough	91	58	67	44	59	65	51	45	63	80	73	11	38	47	71	59
Presqu'ile	66	67	84	25	67	76	55	58	65	31	61	67	63	71	35	62

Table 4. Rawinsonde data in minutes (continued)

Rawinsonde station	Oct. 1		Oct. 2								Oct. 3							
	00	12	00	03	06	09	12	15	18	21	00	03	06	09	12	15	18	21
Stony Point	60	90		89	61	89	65	76	70	84	110	83	109	83	73	71	72	97
Sodus Point	44		59	65		23	64	83	65		66	70	54	74	47	20	45	45
Lakeside	64	81	63	94	49	63	53	50	59	68	62	72	72	71	72	81	67	86
Confederat. Pk.	56	58	65	82	37	81	50	64	57	110	52	78	43	89	56	90	49	76
Scarborough	71	95	69	45	40	71	22	38	42	53	69	87	59	92	86	37	82	63
Presqu'ile	59	65	77	57	73	51	77	83	67	78	66	33	62	67	74	90	67	91

Rawinsonde station	Oct. 4								Oct. 5							
	00	03	06	09	12	15	18	21	00	03	06	09	12	15	18	21
Stony Point	67	85	119	48	65	54	66	98	57	90	78	56	134	72	71	66
Sodus Point	0	47	80	39	67	69	57	74	58	62	73	52	68	86	70	83
Lakeside	64	73	51	56	68	30	62	62	54	79	30	89	61	69	64	53
Confederat. Pk.	56	110	38	77	50	80	69	81	56	125	41	54	47	131	50	85
Scarborough	46	56	55	38	89	78	63	54	47	73	51	70	65	64	61	74
Presqu'ile	70	73	71	73	68	89	77	89	46	67	58	69	54	6	59	75

Rawinsonde station	Oct. 6								Oct. 7							
	00	03	06	09	12	15	18	21	00	03	06	09	12	15	18	21
Stony Point	71	65	89	70	62	87	75	4	101	5	5	113	79	67	70	69
Sodus Point	74	95	68	44	66	89	60	25	62	50	69	29	59	34	46	33
Lakeside	61	65	69	73	78	63	68	12	56	72	110	62	73	56	62	68
Confederat. Pk.	56	122	70	76	51	57	58	94	61	69	50	63	45	71	46	69
Scarborough	3	56	63	82	54	69	58	78	22	41	65	72	66	54	66	
Presqu'ile	61	60	57	58	51	90		72	65	70	65	66	62	49	55	51

Table 4. Rawinsonde data in minutes (continued)

Rawinsonde station	Oct. 8								Oct. 9							
	00	03	06	09	12	15	18	21	00	03	06	09	12	15	18	21
Stony Point	85	86	77	81	86	44	46	56	55		67	53	64	37	26	55
Sodus Point	66	34	51	54	67	53	56	58	56	62	68	59		63	69	76
Lakeside	61	82	89	83	72	54	58	43	64	58	7	59	53	45	56	55
Confederat. Pk.	51	63	58	66	50	53	43	50	51	77	54	54	57	50		67
Scarborough		67	79	66	58	42		54	33	52	63	56	79	40	73	51
Presqu'ile	66	67	53	66	50						60	23	70	58	50	51

Rawinsonde station	Oct. 10								Oct. 11							
	00	03	06	09	12	15	18	21	00	03	06	09	12	15	18	21
Stony Point	65	61	77	52	57	61	82	77	66	94	76	90	99	86	93	87
Sodus Point		50	55	58	74	41		87	55	23	64	126	52	62	60	75
Lakeside	47	50	63	66	67	17	66	78	76	96	36	85	63	78	58	76
Confederat. Pk.	53	51	59	68	46	40	45	72	58	85	54	35	49	3	65	78
Scarborough	55	36	72	57	57		63	36	83	85	73	62	59	56	75	59
Presqu'ile	63	71	64	62	74	73	54	51	62	70	56	71	63	40	51	69

Rawinsonde station	Oct. 12								Oct. 13							
	00	03	06	09	12	15	18	21	00	03	06	09	12	15	18	21
Stony Point	67	0	51	76	72	71	61	60	79	57	68	69	70	80	39	89
Sodus Point	66	67	65	33	51	34	69	68	3	23	68	53	62	87		29
Lakeside	63	83	60	67	66	82	83	73	76	64	62	66	66	77	67	73
Confederat. Pk.	56	69	53	70	57	29	44	52	59	55	50	58	45	68	58	69
Scarborough	52	31	73	64	59	83	12	25	58	61	42		48	64	61	0
Presqu'ile	49	67	63	70	51		33	59	6	54	54	61	58	48	62	67

Table 4. Rawinsonde data in minutes (continued)

Rawinsonde station	Oct. 14								Oct. 15							
	00	03	06	09	12	15	18	21	00	03	06	09	12	15	18	21
Stony Point	59	66	75	60	71	62	17	70	41	49	66	68	72	62	75	58
Sodus Point	52	40	42	6	71	63	62	33	44	63	64		54	40	69	41
Lakeside	67	86	69	79	66	33	61	32	46	39	3	47	50	44	69	61
Confederat. Pk.	59	59	88	62	41	67	57	49	51	34	54	55	43	61	53	54
Scarborough	13	62	66		54	53	35	57	43	50	62	43	55	51	66	70
Presqu'ile	17	51	43	59	60	40	70	52	49	1	53	55	51	41	60	40

Rawinsonde station	Oct. 16								Oct. 17							
	00	03	06	09	12	15	18	21	00	03	06	09	12	15	18	21
Stony Point	31	59	0	68	64	61	67	30	61	49	18		61	78	98	59
Sodus Point	52	62	70	36	60	61	62	40	29	50	71	72	55	68	62	44
Lakeside					50	73	61	62	53	53	61	49	67	59	59	78
Confederat. Pk.	49	56	47	51	53	59	48	61	52	22	49	52	47	57	46	35
Scarborough	73	55	68		57	49	29	48	46	52	63	22		53	44	35
Presqu'ile	58	55	50	59	53	43	62	62	53	47	57	27	57	47	74	32

Rawinsonde station	Oct. 18								Oct. 19		Oct. 20		Oct. 21		Oct. 22	
	00	03	06	09	12	15	18	21	00	12	00	12	00	12	00	12
Stony Point	65	41	57	58	50	41	57	63	60	69		70	68	71	50	56
Sodus Point	58	37	66	38	63	52	62	65	63	61	60	70	33	68	25	57
Lakeside	66	57		64	63	41	62	47	40	56	48		65	79	61	65
Confederat. Pk.	53	48	47	55	10	54	51	55	29	57	48	69	50	60	46	61
Scarborough	41	52	36	36	54	59	47	62	62	52	65	38	90	50	49	55
Presqu'ile	51	58	56	63	69	64	54	51	65	63	72	61	65	55	50	63

Table 4. *Rawinsonde data in minutes (continued)*

Rawinsonde station	Oct. 23		Oct. 24		Oct. 25		Oct. 26		Oct. 27		Oct. 28		Oct. 29	
	00	12	00	12	00	12	00	12	00	12	00	12	00	12
Stony Point	46	84	61	66	19	75	53	59	59	75	54	53	58	107
Sodus Point	50	60	50	57	56	60	43	80	59	50	59	48	66	71
Lakeside	65	74	55	62	77		60	61	46	67	52	59	47	75
Confederat. Pk.	64	57	46	51	45	47	45	51	46	44	51	58	49	54
Scarborough	67	77	63	60	50	75	46	76	69	75	47	46	43	59
Presqu'ile	54	56	49	68	51	67	67	62	61	70	57	60	64	45

Rawinsonde station	Oct. 30								Oct. 31							
	00	03	06	09	12	15	18	21	00	03	06	09	12	15	18	21
Stony Point	48	61	61	51	72	80	73	86	55	71	64	70	77	81	57	75
Sodus Point	50	50	68	58	63	64	62	54	49	47	60	34	60	83	58	52
Lakeside	44	59	15	73	72	84	66	63	56	57	59	79	59	70	59	49
Confederat. Pk.	49	38	25	52	48	21	49	52		66	46	32	12	56	47	46
Scarborough	34	33	80	45	39	25	77	67	53	35	57	82	69	70	34	33
Presqu'ile	49	83	62	67	77	58	86	79	54	65	61	57	59	47	66	64

Rawinsonde station	Nov. 1								Nov. 2							
	00	03	06	09	12	15	18	21	00	03	06	09	12	15	18	21
Stony Point	54	31	57	42	61	69	48	80	46	67	67	55	104	67	65	95
Sodus Point	51	55		65	69	52	69	37	49	52	65	68	4	47	58	77
Lakeside	46	61	62	61	62	82	62	63	49	68	61	12	109	76	62	54
Confederat. Pk.	55	61	54	35	42	39	45	57	50	58	49	16	37	41	44	30
Scarborough	24	27	74	83	57	43	54	54	45	64	55	70	18	66	54	9
Presqu'ile	49	66	53	65	70	71	50	66	58	66	66	68	71	72	44	70

Table 4. Rawinsonde data in minutes (continued)

Rawinsonde station	Nov. 3								Nov. 4							
	00	03	06	09	12	15	18	21	00	03	06	09	12	15	18	21
Stony Point	64	42	51	49	54	31	61	68	6	48	68	43	24	49	61	66
Sodus Point	48	46			54	68	58	66	63	45	109	66	64	25	61	42
Lakeside	44	70	63	55	61	61	60	53	54	1	58	69	65	69	63	75
Confederat. Pk.	26	17	21	21	50	62	41	14	51	56	59	52	51	81	47	77
Scarborough	44	40	7	65	71	51	58	69	52	56	75	85	47	29	53	70
Presqu'ile	46	63	59	49	48	61	55	62	41	35	51	65	62	41	54	53

Rawinsonde station	Nov. 5								Nov. 6							
	00	03	06	09	12	15	18	21	00	03	06	09	12	15	18	21
Stony Point	16	38	56	75	68	52	65	57	71	81	65	83	69	67	70	24
Sodus Point	38	37		17	64	23	65	31	62	38	65	23	65			51
Lakeside	48	55	52	57	66	54	58	63	60	54	61	57	67	66	66	77
Confederat. Pk.	59	69	52	36	54	78	52	57	54	59	48	61	50	48	50	74
Scarborough	10	86	69	94	55	49	47	26	52	47	78	50	60	77	58	38
Presqu'ile	55	57	52	62	67	63	57	40	58	62	66	59	51	62	57	50

Rawinsonde station	Nov. 7								Nov. 8							
	00	03	06	09	12	15	18	21	00	03	06	09	12	15	18	21
Stony Point	69	66	61	71	60	76	63	77	49	22	90	53	2	38	51	61
Sodus Point	47	83		70		33	64	42	61	46	53	46	78	62	71	57
Lakeside	62	67	61	59	61	65	60	91	91	77	83	24		67	52	40
Confederat. Pk.	41	63	44	62	45	58	49	50	64	50	51	47	44	30	42	67
Scarborough	47	31	63	48	50	33	29	44	52	61	55	56	52	42	35	30
Presqu'ile	40	52	58	36	86	52	57	53	68	37	59	30	27	57	42	63

Table 4. Rawinsonde data in minutes (continued)

Rawinsonde station	Nov. 9								Nov. 10							
	00	03	06	09	12	15	18	21	00	03	06	09	12	15	18	21
Stony Point	56	70	58	11	74	67	50	57	58	53	67	65	69	71	61	78
Sodus Point	53	36	21		30	61	50	66	48	73	60	93	69	26	62	35
Lakeside	51	62	23	59	55	67	59	71	50	55	60	52	65	58	61	58
Confederat. Pk.	48	47	8	0	42	74	53	56	50	39	54	54	52	60	55	43
Scarborough	63	85	76	80	49	67	45	69	63	83	65	69	53	67	50	23
Presqu'ile	59	60	53	49	57	65	89	52	63	66	62	55	69	63	57	49

Rawinsonde station	Nov. 11								Nov. 12							
	00	03	06	09	12	15	18	21	00	03	06	09	12	15	18	21
Stony Point	70	67	57	60	58	58	74	61	42	70	62	74	70	50	63	52
Sodus Point	55	63	62	60	77	14	57	17	90	78	69	23	66	38	62	31
Lakeside	51	46	61	53	70	66	56	47	48	39	57	72	65	88	65	49
Confederat. Pk.	51	48	46	70	47	61	53	50	48	54	46		56	63	48	55
Scarborough	37	65	67	75	20	13	4	78	55	92	55	72	50	83	51	70
Presqu'ile	63	55	57	41	48	58	43	67	51	61	45	65	60	56	49	60

Rawinsonde station	Nov. 13								Nov. 14							
	00	03	06	09	12	15	18	21	00	03	06	09	12	15	18	21
Stony Point	43	47	63	53	62	58	65	53	68	45	54	3	67	1	64	51
Sodus Point	45	38	59	55	61		61	32	63		51	54		50	48	81
Lakeside	42	79	61	57	59	47	60	26	53	113	12	58	36	1		
Confederat. Pk.	48	36	41	53	49	43	46	57	46	53	43	12	26	42	53	39
Scarborough	70	81	77	24	37	7	48	67	64	66	49	67	28	58	42	1
Presqu'ile	3	60	61	61		54	57	45	59	59	41	54	56	40	51	53

Table 4. *Rawinsonde data in minutes (continued)*

Rawinsonde station	Nov. 15		Nov. 16		Nov. 17		Nov. 18		Nov. 19		Nov. 20	
	00	12	00	12	00	12	00	12	00	12	00	12
Stony Point	47	78	61	65	56	61	49	71	58	53	52	67
Sodus Point	47	78	61	65	56	61	49	71	58	53	52	67
Lakeside	38		54				47	65	67	60	42	50
Confederat. Pk.	54	58	45	52	44	45	42	46	43	47	48	43
Scarborough	100	49	62	64	67	72	51	74	12	59	48	66
Presqu'ile	46	61	56	62	37	63	57	55	62	66	51	52

Rawinsonde station	Nov. 21								Nov. 22							
	00	03	06	09	12	15	18	21	00	03	06	09	12	15	18	21
Stony Point	60	74	57	52	71	75	71	69	63	93	0	49	73	77	64	58
Sodus Point	46	88	62	51	83	102	74	65	70	45	61	66	67	54	67	49
Lakeside	47	55	64	54	62	53	64	69	58	73	62	53	66	48	63	51
Confederat. Pk.	46	50	51	51	50	58	47	52	52	55		51	53	56	46	52
Scarborough	45	30	44	60	77	71	78	65	44	70	55	61	66	67	58	68
Presqu'ile	57	47	46	53	50	59	69	60	55	62	54	50	33	50	57	53

Rawinsonde station	Nov. 23								Nov. 24							
	00	03	06	09	12	15	18	21	00	03	06	09	12	15	18	21
Stony Point	62	63	59	57	47	96	64	79	57	73	63	61	64	69	68	50
Sodus Point	75	78	66	121		4	76	91	76	94	62	48	89	59	65	58
Lakeside	57	56	57	53	66	61	60	52	57	59	58	59	62	74	59	53
Confederat. Pk.	49	59	58	51	46	59	49	57	51	44	49	45	48	54	40	38
Scarborough	65	63	45	42	62	87	67	42	61	38	56	66	54	67	66	56
Presqu'ile	19	26	53	47	46	47	38	47	56	67	37	56	65	53	65	51

Table 4. *Rawinsonde data in minutes (continued)*

Rawinsonde station	Nov. 25								Nov. 26							
	00	03	06	09	12	15	18	21	00	03	06	09	12	15	18	21
Stony Point	55	77	42	79	74	70	57	60	66	25	57	56	62	51	50	34
Sodus Point	67	41	54	45	66	51	63	36	59	57	40	11	79	60	70	54
Lakeside	51	64	57	75	64	21	60	52	56	33	58	50	84	10	54	37
Confederat. Pk.	52	49	55	56	45	46	42	23	43	51	43	51	41	54	42	39
Scarborough	68	69	69	77	60	71	33	39	53	63	66	56	50	73	45	32
Presqu'ile	63	60	63	60	60	39	60	24	58	50	48	55	55	14	55	45

Rawinsonde station	Nov. 27								Nov. 28							
	00	03	06	09	12	15	18	21	00	03	06	09	12	15	18	21
Stony Point	68	33	58	34	67	42	54	39	66	35	49	50	43	40	42	48
Sodus Point	59	41	75	31	66	40	57	50	73	50	63				60	57
Lakeside	56	46	55	54	67	61	63	61	52	34	53	45			59	43
Confederat. Pk.	53	49	53	80	45	52	46	51	51	47	52	52	46	28	53	48
Scarborough	46	75	55	67	59	62	54	54	50	68	61	67	43	55	87	61
Presqu'ile	50	57	41	43	63	40	67	35	60	48	57	43	53	51	50	46

Rawinsonde station	Nov. 29								Nov. 30							
	00	03	06	09	12	15	18	21	00	03	06	09	12	15	18	21
Stony Point	43	46	61	45	43	30	35	33	44	45	55	27	49	47	55	48
Sodus Point	63	62	67	58	58	55	57	25	62	27	73	50	61	58	58	38
Lakeside	58	48	50	42	51	47	66	59	54	55	51	53	59	55	46	54
Confederat. Pk.	50	56	52	37	47	44		55	50	52	51	58	44	55	55	32
Scarborough	36	63	62	73	51	22	66	47	47	48	43	57	45	39	56	53
Presqu'ile	53	50	54	34	60	49	61	42	31	45	52	40	56	38	55	17

Table 4. Rawinsonde data in minutes (continued)

Rawinsonde station	Dec. 1								Dec. 2							
	00	03	06	09	12	15	18	21	00	03	06	09	12	15	18	21
Stony Point	55	65	59	57	50	50	44	33	43	36	59	53	53	48	46	35
Sodus Point	59	48	66	45	67	25	57	27	56	25	60	53	61	42	51	22
Lakeside	58	57	55	57	71	41	62	56	57	44	50	43	62	53	57	50
Confederat. Pk.	51	45	50	48	42	47	37	49	50	29	49	46	52	51	53	53
Scarborough	40	50	43	58	72	53	63	60	64	46	57	58	70	48	58	65
Presqu'ile	45	51	29	44	53	46	64	38	47	50	31	44	51	54	58	

Rawinsonde station	Dec. 3								Dec. 4							
	00	03	06	09	12	15	18	21	00	03	06	09	12	15	18	21
Stony Point	38	41	39	38	49	39	52	59	60	47	53	69	59	42	61	47
Sodus Point	67	35	59	35	71	45	53	51	52	44	63	41	51	30	62	29
Lakeside	56	49	53	41	69	57	56	53	53	5	36	70		54	59	57
Confederat. Pk.	55	8	42	44	42	53	49	53	50	60	52	51	29	45	47	37
Scarborough	64	61	54	21	47	62	67	66	70	65	51	63	46	30	47	48
Presqu'ile	60	54	50	41	45	63	27	55	67	53	52	45	47	33	51	57

Rawinsonde station	Dec. 5								Dec. 6							
	00	03	06	09	12	15	18	21	00	03	06	09	12	15	18	21
Stony Point	62	56		63	69	74	65	65	44	59	53	51	40			62
Sodus Point	45	37	46	61	58	53	56	19	50	49	55	14	46	55	55	51
Lakeside	45	54	41	62	64	55	51	57	47	74	42	51	62			37
Confederat. Pk.	50	37	41	52	42	54	47	49	43	56	50	67	49	25	33	19
Scarborough	79	61	59	52	49	63	42	60	56	72	65	79	90	21	43	49
Presqu'ile	51	22	66	23	56	38	51	60	65	54	51	42	56	51	43	38

Table 4. *Rawinsonde data in minutes (continued)*

Rawinsonde station	Dec. 7								Dec. 8							
	00	03	06	09	12	15	18	21	00	03	06	09	12	15	18	21
Stony Point	50	45	54	3	54	54	47	43	56	57	56	41	63	28	57	0
Sodus Point	44	24	41	65	49	47	66	30	54	35		39	50	51	62	20
Lakeside	46	43	47	67	85	56	66	48	45	56	45	45	61	55	61	55
Confederat. Pk.	36	48	46	47	52	44	49	44	53	56	38	43	47	46	43	34
Scarborough	67	73	70	62	47	72	54	65	70	58	31	64	11	54	45	68
Presqu'ile	47	46	52	51	58	36	58	42	49	48	53	54	69	45	45	53

Rawinsonde station	Dec. 9								Dec. 10							
	00	03	06	09	12	15	18	21	00	03	06	09	12	15	18	21
Stony Point	47	59	50	47	71	57	67	44	45	96	49					
Sodus Point	59	74	52	66	47	76	54	68	48	69	47	58				
Lakeside	55	59	57	59	54	47	60	58	45	5						
Confederat. Pk.	38	52	46	57	48	46	55	54	41	37	42	63	50	54	50	42
Scarborough	42	59	63	41	47	78	49	68	53	63	36	56	53	6	65	14
Presqu'ile	31	52	62	54	50	18	66	51	51	23	42	53	58			

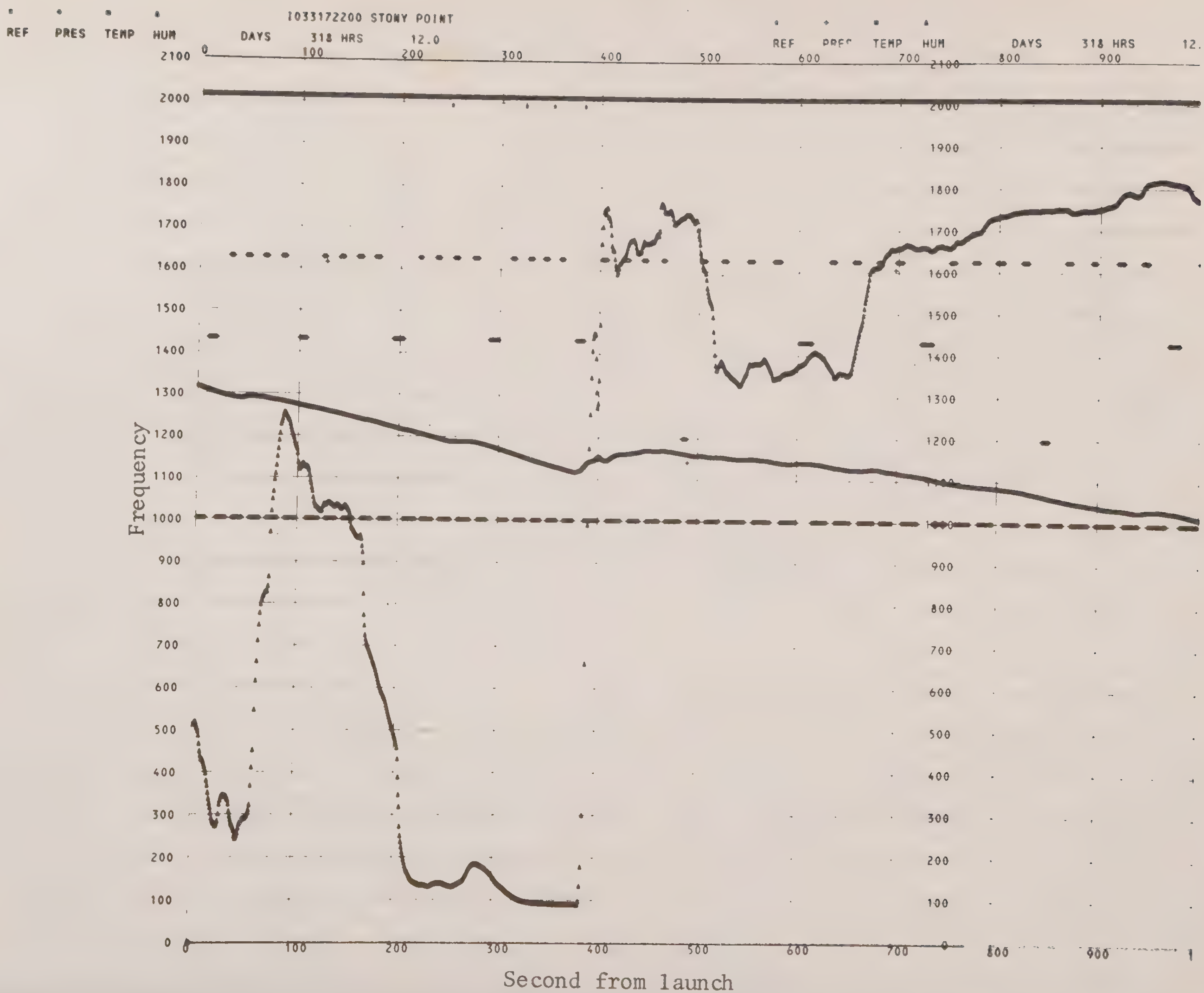

Figure 5. Sample time-series plot of original, unedited rawinsonde meteorological data.

FROM THE DESK OF THE U.S. IFYGL COORDINATOR

The following is a slightly abbreviated version of a paper on the U.S. IFYGL rawinsonde system presented at the Sixteenth Conference on Great Lakes Research, IAGLR, in Huron, Ohio, on April 17, 1973.

IFYGL Rawinsonde System Operation

Cornelius J. Callahan
U.S. Coordinator
IFYGL

This is a report on the overall operations of the rawinsonde system used in the International Field Year for the Great Lakes. It has two major objectives:

- To provide data users with factual information on the equipment, techniques, and procedures used, and, more important, on the operational results.

- To provide investigators planning similar programs in the future with operational details on capability, performance, manpower, and cost factors to aid in planning, logistics, and the decision-making process.

These two purposes exclude a rather important topic -- the accuracy of the data acquired. This information is not available as yet, because the data have not been processed.

Cost and time considerations resulted in the establishment of the rawinsonde network shown in figure 6.

The Scarborough station was located at a permanent installation, the Upper Air Training School of the Atmospheric Environment Service in eastern metropolitan Toronto. The other stations were located in trailers.

The exact locations were based on a number of considerations, including absence of obstacles and radio interference. As is usually the case, no station met every criterion for an ideal location; however, all stations met most of the requirements.

In the fall of 1971, agreement was reached on the use of (1) the LO-CATE rawinsonde system, manufactured by Beukers Laboratories, Inc., and (2) a special sonde, jointly designed by Beukers and VIZ Manufacturing Co. and manufactured by the latter.

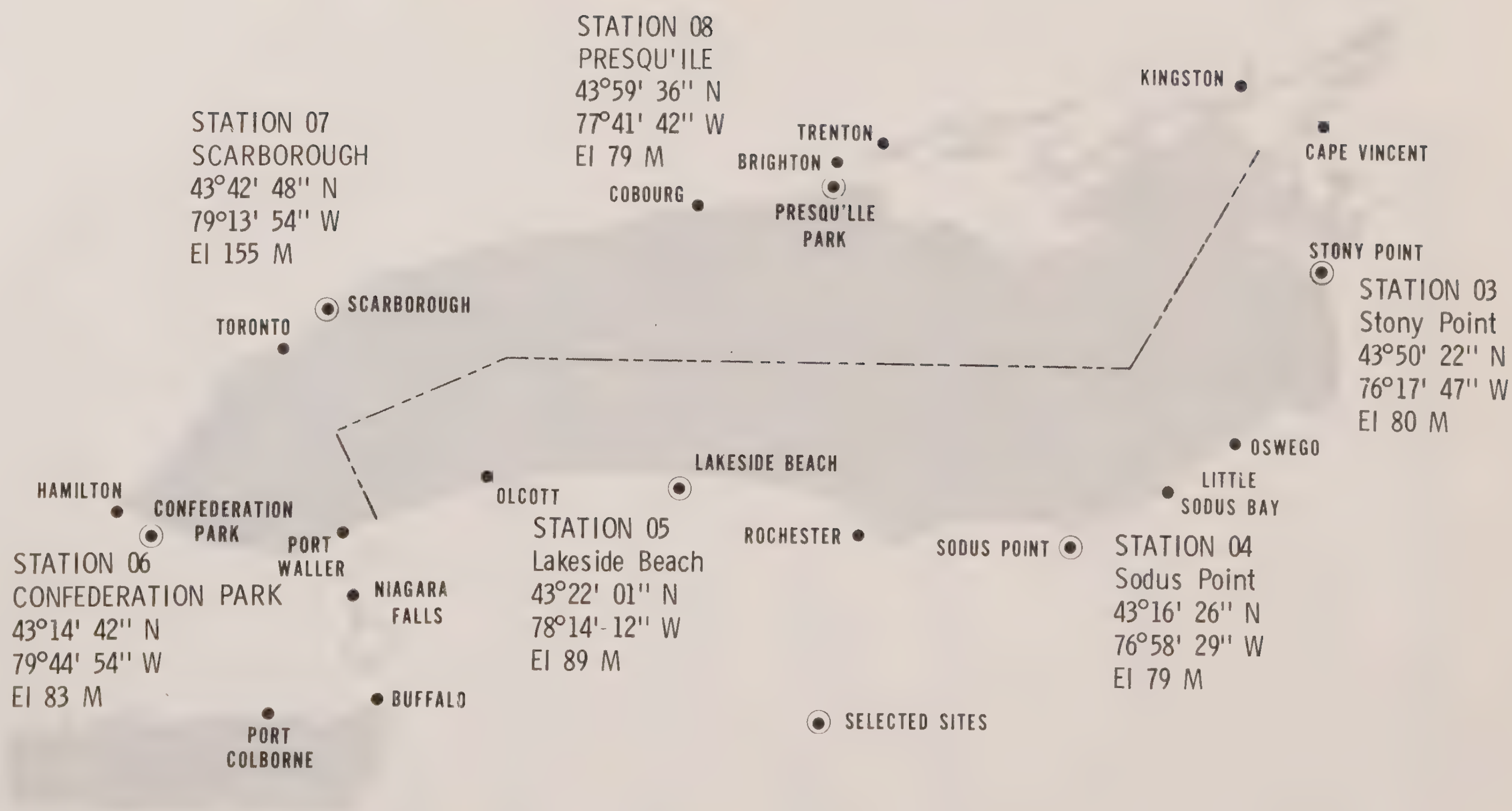

Figure 1. IFYGL rawinsonde network.

The sonde was equipped to receive Loran-C navigational signals, and to transmit them to a computer-equipped Beukers ground station every 2 sec, three times as fast as comparable readings from usual GMD equipment. A teletype printout of winds was obtained for each minute. The sonde operated on a clock commutator, providing thermodynamic data every 0.8 sec instead of every few seconds, as in the case of the GMD-2. The system provided much more resolution than the usual upper air equipment in routine use.

It was recognized that the operational use of a new data acquisition system, with an accompanying lack of demonstrated reliability was accompanied by risk. This was countered by the provision of additional maintenance capability. However, the governing factor in the decision was the scientific requirement for information much more detailed than could be obtained from the normal upper air observations, and so the calculated risk was taken. A decision of considerable operational importance was made to add a strip chart recorder to the output paralleling the tape recorded area.

While our forecasts of instrumental logistics problems proved correct, the observational program was operationally successful.

From September 14 to December 8, four intensive periods were scheduled, during which eight sondes per day would be released by each of the six stations involved. Each U.S. station had seven operators assigned, all from the 6th Weather Squadron, Air Weather Service, USAF. The Canadian complement was four men per station, with some overlapping in shifts during intensive periods.

The following specifications for a successful run were established:

- A release at the specified hour and to 5 min after it.
- Recording of apparently "good" data to the 400-mb level or higher.

During nonintensive periods, when 2 runs per day per station were made, the objective was to reach 100 mb or higher. Balloon downtracking was used on the 400-mb flights to provide additional potential useful data.

Though stations and operating frequencies were selected on the basis of climatological winds to minimize radio interference between airborne packages, day-to-day wind deviations from climatology were sufficiently serious to require a reallocation of frequency within the range of 400 to 406 MHz. This was accomplished by a centralized control at Rochester, N.Y., where the operation of the entire rawinsonde network was directed by CM Sgt. William Rummel, 6th Weather Squadron, USAF, who served as Net Control Officer. Radio communications were maintained between Rochester and the stations, and commercial telephones were used to communicate with the Canadian stations. These communications systems were also used for logistics and maintenance matters.

Turning to operational performance, table 1 shows a summary of scheduled versus actual releases and data percentages obtained.

Table 1

	Scheduled releases (No.)	Actual releases (No.)	Actual vs. scheduled releases (%)	Data to required heights (No.)	Data to required heights for scheduled releases (%)	Data to required heights for actual releases (%)
United States	1,548	1,479	95.5	1,291	83.4	87.3
Canada	1,533	1,511	98.6	1,358	88.6	89.9
Total	3,081	2,990	97.0	2,649	86.0	88.6

Again note that there is as yet no information on the accuracy of these soundings. It should also be noted that these results are operationally similar to what would have been expected from the rawinsonde systems used by the National Weather Service - somewhat surprising in view of the essentially experimental nature of the equipment used in IFYGL.

As shown in table 2, failures can be divided into two categories: cases in which the desired height was not reached (incomplete runs) and cases in which no release was made.

Table 2

	Incomplete run	No release	Total
United States	188	69	257
Canada	153	22	175
Total	341	91	432

Reasons for the 341 incomplete runs are given in table 3.

Table 3

Reason for incomplete runs	United States	Canada	Total
Balloon burst	38	43	81
Leaking balloon	1	5	6
Balloon forced down (icing, heavy precipitation, etc.)	21	3	24
Sonde failure	73	62	135
Power failure	3	0	3
Ground equipment failure	18	12	30
Strong winds	15	6	21
Signal interference from another sonde	19	22	41
Total	188	153	341

Reasons for the 91 cases in which no release was made are given in table 4.

Table 4

Reason for nc release	United States	Canada	Total
Operator error	2	2	4
Ground equipment failure	39	17	56
Power failure	6	0	6
	22	3	25
Total	69	22	91

With these preliminary analyses completed, we can now look at the total number of failures (432, or 11.4 percent of the desired runs) and categorize the causes, as shown in table 5.

Table 5

Cause of failure	United States	Canada	Total
Materiel			
Balloon burst	38	43	81
Leaking balloon	1	5	6
Sonde failure	73	62	135
Ground equipment failure	57	29	86
No rawinsondes on hand	22	3	25
Signal interference from other sondes	19	22	41
Total	210	164	374
Noncontrollable factors			
Balloon forced down; icing	21	3	24
Power failure	9	0	9
Strong winds	15	6	21
Total	45	9	54
Operator error	2	2	4
TOTAL	257	175	432

Overall statistics of causes of failure are summarized in table 6.

Table 6

Causes of failure	Failures (No.)	Failures (%)	Total runs made (%)	Total runs desired (%)
Materiel	374	86.6	12.5	12.1
Noncontrollable	54	12.5	1.8	1.7
Operator error	4	.9	---	---
Total	432	100.0	14.3	13.9

Of course, any failure analysis has a parallel series of statistics indicating successes. It should again be stressed that 432 failures were experienced out of a total of 3,081 desired runs. Because this paper is intended to provide future users of the system with factual information on the probability of success it has necessarily been slanted at the reasons for failures. We should not, however, lose sight of the fact that we consider the overall operation highly satisfactory.

In summary, an operationally successful rawinsonde program was conducted during IFYGL with Beuker's LO-CATE equipment and the VIZ rawinsonde instruments. Since these systems were being used for the first time in large numbers on a scheduled basis, problems were anticipated, occurred, and were generally solved during the operation itself. Although a complete test cycle is desirable time did not permit this, and the overall success rate of about 86 percent is considered highly satisfactory.

Data are now being reduced and will be available through the IFYGL Data Managers. When data are available, a more complete analysis of rawinsonde system performance will be possible. Information on data availability is being circulated through various IFYGL Publications.

Material for this paper has been abstracted from a forthcoming technical report in the IFYGL series, providing much more detail on the IFYGL rawinsonde system.

Acknowledgments

The author expresses his thanks to CM Sgt. William Rummel, 6th Weather Squadron, USAF, and to James McCulloch, Atmospheric Environment Service, Canada, for their contribution to this report.

☆ U. S. GOVERNMENT PRINTING OFFICE :1973--542-647/3